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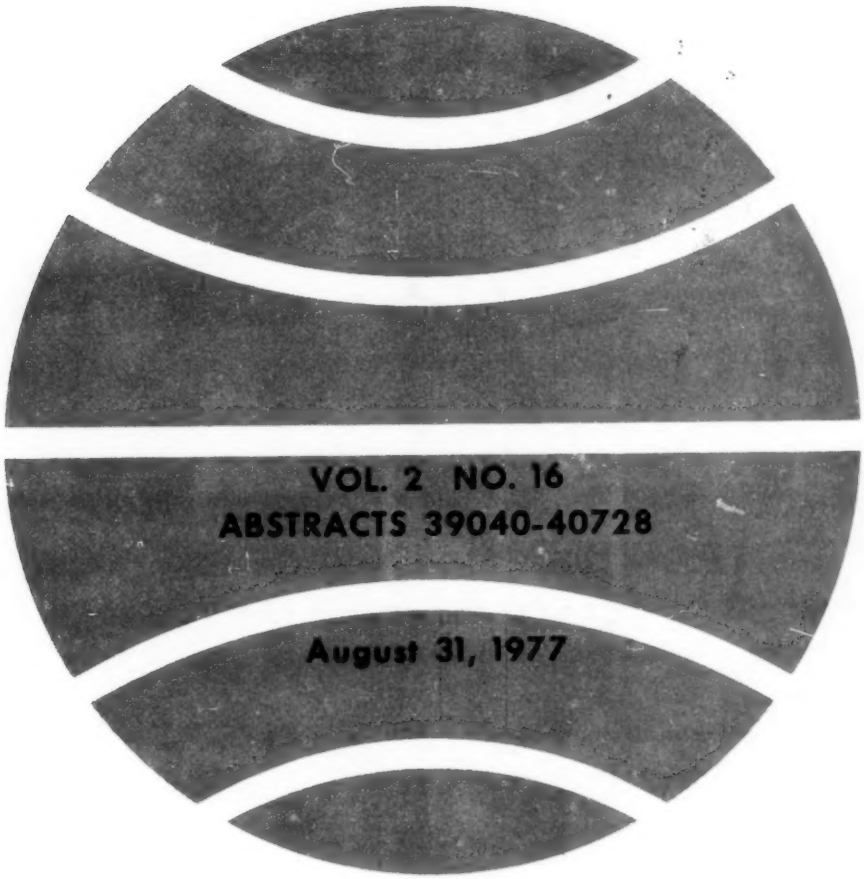

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ERDA ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 39663

39040 (IS-ICP—37) **Iowa Coal Research Project. Interim report.** (Iowa State Univ. of Science and Technology, Ames (USA). Energy and Mineral Resources Research Inst.). 15 Jan 1977. 36p. P 03/MF A01.

Economic assessments continue to affirm the economic disadvantages Iowa faces in marketing Iowa coal. These disadvantages stem from competitive coals having: (generally) lower sulfur; lower mining costs resulting from the larger scale mining operations which, in turn, result from generally larger coal deposits; and for certain users who are of a larger size and/or located in eastern or western Iowa, transportation cost advantages through use of barges and/or unit trains. Iowa coals are usually high sulfur (more than 5 percent) and are difficult to desulfurize because much of the sulfur is present either as very finely disseminated pyrites or as organically bound sulfur, both of which require special techniques to remove. Generally only 30 to 50 percent of the sulfur is present in coarse or massive forms of pyrite which can be removed by the float-sink separation methods in commercial use. The present research effort has been directed at developing methods for removing disseminated pyrites and organic sulfur. In order to separate the finely disseminated pyrites from coal, the coal must first be ground as fine as talcum powder. Soaking in liquid anhydrous ammonia before grinding helps to free the pyrites from the coal. After grinding, the coal and pyrite particles may be separated by either froth flotation or selective oil agglomeration. The separation obtained by these methods was far from ideal before the advent of the Iowa Coal Project. Recently basic technological improvements have been made which involve applying a unique pretreatment step which apparently alters the surface of the pyrite particles so that a much better separation of coal and pyrite particles is obtained subsequently by either froth flotation or oil agglomeration. The operation of the university's demonstration coal mine and land reclamation project are reported.

39041 **Utilization of coal: key-note address.** Krishna, M.G. (Central Fuel Research Inst., Dhanbad, India). *J. Inst. Eng. (India), Chem. Eng. Div.;* **57**: 1-3(Oct 1976).

In the context of the energy supply situation in India and abroad, a review of the subject of utilization of coal is timely and appropriate; more so, after the recent increase in the price of crude oil. It has become customary to discuss mainly conversion process technology, while reviewing the subject of utilization of coal. The associated steps that precede and succeed actual processing or utilization of coal are often either overlooked or considered as not falling in their domain by the technologist and engineer who actually use coal. A large number of the current problems in coal utilization in India can be traced to the deficiencies in the pre-treatment and handling steps, apart from distribution and other management problems, that precede coal utilization and processing. Most of the users of coal in India are not yet adequately conscious of the post utilization steps such as by-product recovery, effluent treatment and waste recycle. All these factors affect efficiency and economics. It is, therefore, necessary in these modern times, to take an integrated view of coal utilization covering the whole spectrum of activities from the time coal is brought to surface until its constituents are fully utilized. The review should, therefore, start with an awareness of the quality of the resource and pass through pre-treatment, processing and application. These various steps, obviously, depend on the pattern of end use.

PROCESSING

39042 **Role of apparatus equipment in chemical solid fuel processing.** Zykow, D.D. (Moscow Inst. of Chemical Building Products). *Koks, Smola, Gaz;* **22**: No. 1, 1-5(Jan 1977). (In Polish).

The predominant role of apparatus and equipment in solving problems of solid fuel processing is stressed. Basic processes are analyzed. Elementary processes are component parts of complex schemes and are synthesized into industrial systems. The findings are illustrated by an example of a multicomponent mixture rectification and of a combination of this process with crystallization.

CARBONIZATION

REFER ALSO TO CITATION(S) 39108, 39109, 39121, 39122

39043 (NP-tr—1961) **Dynamics of the formation of and changes in the products of the thermal decomposition of coking coals on carbonization.** Biryukov, Yu.V. Translated from *Metall. Koksokhim.;* No. 8, 29-36(1968). 11p. U 02/MF A01.

When coal is thermally treated a complex of reactions proceeds in parallel and in succession involving decomposition and the redevelopment of a structure. It is possible from the results of the integral separation under conditions in which the mobile liquid products are removed from the sphere of activities at the moment of their formation to estimate approximately the extent and intensity of the processes of decomposition of the original substances in the coal. It is possible from the results of the local separation from the coal of its mobile liquid fraction to judge the extent and intensity of the cumulative effect of decomposition and restructuring, inasmuch as the mobile liquid products formed at lower temperatures than the temperature of local separation participate in the reactions of conversion to solid or vaporous and liquid products. The point at issue is the assessment of such effects of the decomposition and restructuring reactions, that cannot be resolved without recourse to other methods. The information obtained in the investigations confirms that the yield of volatile vaporous and gaseous products on local separation exceeds by a definite amount the yield of volatile products on integral separation under the same condition of the temperature of decomposition. On local separation the liquid products are not removed from the decomposing coal until the temperature of local separation is reached, and so they take part in the reaction. The investigation provides information about the dynamics of the development of the growth of the solid fraction formed as a result of the participation of the mobile liquid products in the reaction.

39044 (NP-tr—1959) **Question of the caking parameter of coals.** Elenskii, F.Z. Translated from *Khim. Tverd. Topl.;* No. 5, 121-123(1970). 10p. U 02/MF A01.

The classification of coals, as in the case of the technological classification of minerals in general, must not only determine the location of the given coal in the classification diagram but must also provide information on its most rational utilization. In the case of coking coals the technological classification must firstly determine the groups of interchangeable coals for use in coking charges and, secondly, the direction of change of the technological properties of the coal charge and the coke obtained from it on substituting one coal by another in the charge. In other words a scientifically based technological classification of coking coals must become a means to be used in the production of coke of a required quality.

39045 (NP-tr—1962) **Changes in the mobile liquid products separating from the plastic mass of coal at the moment when they are formed.** Biryukov, Yu.V.; Lebedev, V.A. Translated from *Metall. Koksokhim.;* No. 22, 3-5(1970). 6p. U 02/MF A01.

Endeavors to study the properties of mobile liquid products from the plastic mass of coal in the form they have assumed at the

moment when they are evolved have made it necessary in many researches to develop special measures to prevent the occurrence of processes causing changes in the initial properties of the liquid phase at the moment when it separates in the receiver during the thermal breakdown in the centrifugal field. The basic difficulties in solving this problem are that the liquid phase in the plastic mass is an extremely unstable product of thermal decomposition owing to processes of degradation with the formation of free radicals, active functional groups, and thermally unstable products. These circumstances bring about a restructuring under the conditions prevailing of the liquid phase immediately after it has separated from the plastic mass. To prevent the occurrence of these processes the temperatures in the receiver for the liquid phase were lowered as much as was possible and special chemical reagents were introduced into the receiver beforehand.

39046 (NP-tr—1971) **Interactions of coals of differing rank during coking.** Khimichenko, A.V. Translated from *Khim. Tverd. Topl.;* No. 1, 48-55(1971). 14p. P 02/MF A01.

A study was made of the reaction occurring between coals of varying rank during coking. Regular features are established with regard to the changing yield of the fluid part from the plastic mass, swelling index, viscosity, and other features of the plastic mass as a function of the composition of the coal mixtures. The features appertaining to the plastic state of varying types of coal mixture, which in their turn govern the specific changes in terms of mechanical strength, are explained. One of the important questions in the chemistry of coals is the development of the theoretical fundamentals underlying the composition of charges for coking purposes. With this in mind, science in this particular sector has been devoted to a study of the way in which the coals of varying rank react during the formation of the plastic mass, during sintering and during the coke formation process, and the changes in properties which are conditioned by these alterations together with the final characteristics of the semicoke and the coke product itself.

39047 (NP-tr—1960) **Concentration of the coke charge by pelleting.** Holub, J.; Koliha, J. Translated from *Sb. Pr. UVP ;* **28**: 43-60(1974). 17p. U 02/MF A01.

In view of the gradual transition of coking plants to bulk operation and the variable quality of the coal in coke charges, any means leading to a higher bulk density of the coal and to a reduction of the abradability of coke, which has become the main quality requirement for blast furnace coke, should be investigated. One of these means is the concentration of the coke charge by its partial pelletization, which was tried on a semi-production scale. During trials of the new technology of briquetting coal for the production of smokeless fuel, it was found that preferentially granulation of the smallest particles of the coal substance takes place. The pellets of 2 to 3 mm formed are relatively firm and form very quickly. In a coke burden they behave like larger grains, which leads to an overall concentration of the charge, which was otherwise achieved by coarse grinding of the individual constituents. It may be assumed that in the course of the coke forming process, these pellets melt down and will not form foci of cracks, as is the case with larger grains of coarsely ground burden. This also has a favorable effect on the quality of the coke.

39048 **Scope of LTC projects in India.** Sarkar, P.K.; Bhaduri, T.J.; Bhargava, M. (Industrial Consulting Bureau Ltd., New Delhi). *J. Inst. Eng. (India), Chem. Eng. Div.;* **57**: 53-58(Oct 1976).

The domestic sector is the largest consumer of energy in India. The results of surveys conducted in several States with a view to determining the fuel consumption pattern, price structure and possibilities of replacement by processed fuels are reviewed in this paper. It is seen that the price-quality relationships are poor for most of the fuels in common use. Continued use of charcoal, firewood, and agrowastes is contrary to national interests from ecological as well as resource points of view. The use of kerosene is causing a continual drain on meagre foreign exchange. The interim solution through soft coke prepared by open stack burning is causing depletion of the limited caking coal reserves and wastage of otherwise recoverable by-products. The need for a processed fuel, toward which a lateral shift must be induced, is established and alternative routes are briefly reviewed. Considering present fuel habits of the common people, lateral shift toward a processed solid fuel rather than gaseous to liquid fuels appears justified. While several schemes like pelletization of high ash caking coals or washery middlings and briquetting of low volatile coals or coke breeze can be taken up in the medium scale sector (investment around Rs 35 to 50 lakhs), on a national scale and alleviation of the fuel shortage should be sought through low temperature carbonization of coal (LTC). The coal resources and processes for LTC are briefly reviewed, with particular emphasis on Indian technology available and adequacy thereof. The questions of pithead vis-a-vis city-based locations is considered and basic requirements for the latter are discussed. The order of investment, profitability and the effect of different factors thereon are discussed.

39049 **Foundry coke from coals with a low content of volatile matter. Part I. Formed coke from coals with a low content of volatile matter.** Billig, P.; Dreszer, K.; Zakrzewski, Z. (Instytut Chemicznej Przerobki Wegla, Zabrze, Poland). *Koks, Smola, Gaz;* **21**: No. 12, 354-359(Dec 1976). (In Polish).

Tests were carried out aimed at obtaining formed coke from lean and anthracite coals as well as from fine-grained pitch coke from the viewpoint of possible utilization of briquettes from the above-mentioned coals as foundry fuel. The strength of the fuel obtained is being mainly considered.

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 39080, 39164

39050 (FE—2033-18) **Hot low Btu producer gas desulfurization in fixed bed of iron oxide-fly ash. Monthly report No. 15, September 1—September 30, 1976; Quarterly report No. 5, July 1—September 30, 1976.** Leuenberger, E.L. (Air Products and Chemicals, Inc., Marcus Hook, Pa. (USA)). 28 Dec 1976. Contract EX-76-C-01-2033. 159p. Dep. NTIS $6.75.

In the hot producer gas desulfurization process an iron oxide-fly ash sorbent will be used in a fixed bed cyclic operation. Specific objectives are sorbent development, definition of scale-up criteria, and commercial process design. An experimental program to study the dynamics of sorbent regeneration was prepared. Six proposed commercial regeneration schemes were reviewed in order to choose the best regeneration gas composition for the experimental program. Analysis of the schemes led to the selection of air/steam regeneration gas. An experimental program was developed to determine the effects of seven operating variables on regeneration dynamics. Differential equations to describe the adiabatic sorption of hydrogen sulfide on iron oxide/fly ash and oxygen on iron sulfide/fly ash were derived. A finite difference computer program was developed to solve these equations. Accuracy checks were made on the computer generated solution. The program was then modified to allow the simulation of a commercial desulfurization process. The final process simulation computer program can be used to simulate desulfurization, sorbent regeneration, or multiple cycles of desulfurization followed by sorbent regeneration.

39051 (ORNL/MIT—237) **Efficiency of particle removal from viscous liquids with a hydroclone.** Trinh, T.; Monge, J.J. Chrusciel, W.A. (Massachusetts Inst. of Tech., Oak Ridge, Tenn. (USA). School of Chemical Engineering Practice). 1 Oct 1976. Contract W-7405-ENG-26. 50p. P 03/MF A01.

The performance of a 10-mm, Dorr-Oliver hydroclone with up to 37-μm-diam dust or fly ash suspended in high viscosity streams was investigated. Liquid flow rates were varied from 0.9 to 4.4 l/min, and the viscosity ranged from 1 to 85 cp. The feed stream contained 5 wt% of particles. Pressure drop across the hydroclone was found to be dependent on flow rate and fluid viscosity. At low flow rates, pressure drop across the hydroclone appeared to increase with viscosity; whereas, at high flow rates this trend was reversed. Overall centrifugal efficiency was found to increase with flow rate and decrease with viscosity. A characteristic depression at small particle diameters and peak at large particle diameters were observed on plots of point efficiency against particle diameter. This trend could be caused by agglomeration of small particles to large aggregates.

39052 **Regenerable sorbent and method for removing hydrogen sulfide from hot gaseous mixtures.** Farrior, W.L. Jr. (to Energy Research and Development Administration). US Patent Application 646,782. 1 Mar 1976. 9p.

Hydrogen sulfide is effectively removed from hot gaseous mixtures useful for industrial purposes by employing a solid absorbent consisting of silica-supported iron oxide in pellet form. The present invention relates generally to a matrix-supported absorbent for removing hydrogen sulfide (H_2S) from hot gaseous mixture, and more specifically to s silica matrix-supported iron oxide composite useful for removing H_2S from fuel gas producers.

39053 **Continuous process for scrubbing out hydrogen sulfide and ammonia from coke oven gas.** Weber, H.; Chouelat, G.; Lauefhutte, D. (to Firma Carl Still). US Patent 4,009,243. 22 Feb 1977. Priority date 18 Nov 1970, German, Federal Republic of (F.R. Germany). 10p.

A continuous process is provided for scrubbing hydrogen sulfide and ammonia from coke oven gases by selectively scrubbing the hydrogen sulfide using aqueous ammonia, then distilling the hydrogen sulfide again from the wash liquor combining the ammonia directly with acids or certain acid salts, e.g., sulfuric acid or ammonium bisulfate, liberating the combined ammonia therefrom by decomposition, and then recycling the released ammonia to the hydrogen sulfide scrubber, thereby increasing the ratio of ammonia to hydrogen sulfide therein. A preferred absorbent for ammonia is monoammonium phosphate. 9 claims, 2 figures.

HYDROGENATION

39054 Coal hydrogenation processes aimed at obtaining pure fuels. Bodzck, D. (Zaklad Petro- i Karbochemii PAN, Gliwice, Poland). *Koks, Smola, Gaz;* 21: No. 12, 362-366(Dec 1976). (In Polish).

Based on literature references actual trends of studies and research in the USA as well as the state of technological elaboration of obtaining pure fuels from coal are presented.

GASIFICATION

REFER ALSO TO CITATION(S) 39380

39055 (ERDA—76-96/2) Coal demonstration plants. Quarterly report, April—June 1976. White, P.C.; Rial, G.A. (Energy Research and Development Administration, Washington, D.C. (USA). Office of Fossil Energy). 1976. 39p. P 03/MF A01.

Overall progress on the Clean Boiler Fuel Demonstration Plant was maintained on schedule. A major new development involved the decision to change to the Texaco gasifier from Koppers-Totzek, which required new engineering effort in many sections and a rework of the overall plant heat and mass balances. Coalcon completed a total of nine calibration runs on the coal feed apparatus at the Tonawanda minitest facility. Technical support involved a successful coal grinding/drying test which confirmed that the mill performance would meet the demonstration plant requirements. Development of Coal Feeders continued with the successful testing of the zero pressure differential centrifugal feeder. Positive displacement feeder model testing was initiated and several modifications were made to the device to improve overall performance and allow better operation. Ingersoll-Rand Research concluded the Phase I effort on the Development of a Continuous Dry Coal Screw Feeder program with the issuance of the Phase I report. Initial testing of the Negri-Bossi V-12 machine was conducted using high volatile bituminous coal from West Virginia. Laboratory testing for the Coal Feeder Development Program centered around ejector and ball conveyor operation. Ejector experiments involved dense phase transport of dry pulverized coal. Fifty transfer tests were made with two types of coal and nitrogen gas. Engineering and Technical Support to ERDA for the Clean Boiler Fuel Demonstration Plant centered on review of completed program work: Process flow sheets, product assurance plans, a configuration management plan, and an integrated logistics support plan. Technical Assistance Services by the Ralph M. Parsons Co. consisted of further effort on conceptual designs of commercial plants. Process design work was done on the oil/gas plant and the Fischer-Tropsch plant, including utility balances, equipment specifications and process flow diagrams.

39056 (FE—2200-12) Evaluation of COED char gasification using Rummel/Otto gasifiers. Lamb, R.H. (Energy Research and Development Administration, Washington, D.C. (USA)). 20 Sep 1976. Contract EX-76-C-01-2200. 18p. P 02/MF A01.

In September 1975, the Ralph M. Parsons company issued R and D Report No. 114 - Interim Report No. 1 concerning the conceptual design and economic analysis of a commercial complex producing oil and power via COED based coal conversion. The Parsons design used fluid bed gasifiers, or char burners, for gasification of COED char. The objective of this task assignment is to investigate the effects of substituting a Rummel/Otto gasification system for the fluid bed gasifiers in the Parsons design. Substitution of the Otto gasification system changes the capital costs and utility requirements for several of the plant units in the complex. The extent of the changes are tabulated. The net results are an increase in fix capital investment from $1,000,000,000. to $1,011,000,000., and a reduction of exportable electric power from 827 MW to 817 MW. All other quantities, such as coal feed, oil and sulfur produced, working capital and operating labor remain unchanged. Operating requirements for the gasifier were derived from data contained in an Otto Company brochure concerning gasification of brown coal at elevated pressure. The data so derived should be checked against experimental data on char gasification in an Otto unit when the information becomes available. The negative results of this study do not necessarily apply to direct gasification of coal in an Otto gasifier. The results only show that, in combination with the COED process, fluid bed gasifiers are more economical.

39057 (FE—2240-19) Process comparison effluent treatment ammonia separation. Final report. Series No. I: F-1. Bonham, J.W.; Atkins, W.T. (Braun (C.F.) and Co., Alhambra, Calif. (USA)). Jun 1975. Contract EX-76-C-01-2240. 11p. Dep. NTIS $3.50.

Commercial concept designs are being developed for candidate coal gasification processes. A part of this effort is to determine if there is an economic justification for recovering ammonia from process waste waters. This report presents the results of that study. Based on the waste water feed and the current product ammonia price used in this study, ammonia recovery is economically attractive. Of the two ammonia recovery processes studied, the USS Engineers process has both lower capital and operating costs and is recommended for use in future commercial concept designs.

39058 (FE—2286-8) Preparation of a coal conversion systems technical data book. Project 8979 quarterly report, August 1—October 31, 1976. (Institute of Gas Technology, Chicago, Ill. (USA)). Dec 1976. Contract EX-76-C-01-2286. 249p. Dep. NTIS $9.00.

The bulk density of coal is discussed. Continuing work on the vapor-liquid equilibrium of NH_3-CO_2-H_2S-H_2O system is described. Solubility of gases in water and that of oils in water are given. Various properties of coal liquids are assembled. Current practices for sampling, storing, handling, and conveying coal are described. Various coal preparation procedures are also presented. Effect of primary factors on product distribution in batch pyrolysis is discussed. Solvent extraction is compared with pyrolysis. A discussion of pyrolysis in tetralin is presented. Design curves for steam-air gasification of char are presented for operation at 15 and 70 atmospheric pressure. Charts are also presented for interpolation of solids residence time at intermediate pressures. A revised version of the empirical correlation for fluidized-bed expansion ratio is presented. In contrast to the earlier correlation, this version is independent of the effect of column diameter of bed expansion at column diameter over 2.5 inches. A "Height of Reference Unit" (HRU) concept is proposed to estimate the degree of solids mixing in fluidized reactors. Six correlations for estimating the pressure drop in dilute phase, vertical lift lines are evaluated by comparison with the available experimental data on coal and related materials. Correlations for estimating slurry properties, such as density, specific heat, thermal conductivity, and viscosity, are given. An evaluation of correlations used to estimate heat transfer coefficients to non-Newtonian slurries is presented.

39059 (FE/1736—T-1) Environmental analysis report for Clean Boiler Fuel Demonstration Plant program at New Athens, Illinois. (Coalcon, New York (USA)). 16 Feb 1977. Contract EX-76-C-01-1736. 534p. P 23/MF A01.

This Environmental Analysis of the proposed COALCON Clean Boiler Fuel Demonstration Plant is based on a Preliminary Engineering Design, Phase 1 of Contract E(49-18)1736 issued by the United States Energy Research and Development Administration. Only a detailed process design and preliminary plant design were authorized under this phase of the Contract. However, planning of environmentally sensitive areas was conducted in sufficient extent to define the ability of the plant to control effluents at acceptable levels. The preliminary design and the conclusions drawn therefrom are conservative and the refined plant design is expected to reduce the environmental impact of the project. Basic conclusions drawn from this report are not expected to change significantly during future design phases. The proposed plant site of the Coalcon Clean Boiler Fuel (CBF) Demonstration Plant, near the town of New Athens, Illinois (Population 2,000), is about thirty miles SE of the St. Louis Metropolitan area.

39060 (FE/1736—T-1(App.)) Environmental analysis report for Clean Boiler Fuel Demonstration Plant program at New Athens, Illinois. (Weston (Roy F.), Inc., West Chester, Pa. (USA)). 16 Feb 1977. Contract EX-76-C-01-1736. 372p. P 16/MF A01.

Detailed environmental data around the proposed COALCON demonstration plant near New Athens, IL are presented. Water quality, air quality, noise (and the applicable standards), biological data (vegetation, mammals, avifauna, reptiles, amphibians, fish, plankton, benthos), population demography, process data, etc. (LTN)

39061 (FE/1736—T-2) Commercial plant process evaluation report (abridged). Coles, E.T. (Coalcon, New York (USA)). 15 Aug 1975. Contract EX-76-C-01-1736. 277p. P 13/MF A01.

Process design concepts, details, and principal findings resulting from the accomplishment of the Commercial Plant Process Evaluation Task, Phase I, of the Clean Boiler Fuel Demonstration Plant Program are presented. The work was performed under U.S. Energy Research and Development Administration Contract No. E(49-18)-1736. The culmination of this Process Evaluation Task marks the first step towards achievement of an operational and economically viable commercial plant for the conversion of high-sulfur coals to liquid fuels. The Clean Boiler Fuel Demonstration Plant, the forerunner of a commercial plant, will be used to "prove out" and optimize the process concepts identified and defined during this Process Evaluation Task. The report is presented in several sections: Background information with regard to the energy-related field and the Clean Boiler Fuel Project, the principal findings and conclusions arrived at from the Process Evaluation Task undertaken, the physical, functional, and environmental characteristics of the Recommended Commercial Plant, economic and product marketability analyses based on the Recommended Commercial Plant design, and additional technical data in support of the recommended process design.A glossary of terms and abbreviations is presented at the end of this report as an aid to understanding the terminology used in this report.

39062 (PB—260664) **Coal conversion technologies. Final report.** Grandys, K. (Illinois Dept. of Business and Economic Development, Springfield (USA). Div. of Energy). 1 Sep 1975. 34p. Q 03/MF A01.

This report gives the reader a brief overview of the most promising technologies in the fields of coal gasification and liquifaction. (GRA)

39063 (UCID—17367) **Computer program for reduction and storage of field data from an in situ coal-gasification experiment.** Clausen, C.W.; Thorsness, C.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Jan 1977. Contract W-7405-ENG-48. 60p. P 04/MF A01.

A computer program designed for on-site use during the in situ coal-gasification stage of the Hoe Creek Experiment No. 1 is described. The program, written in BASIC and designed specifically for use on a Computer Automation Corporation ALPHA-16 computer, fulfills two major objectives: (1) storing of field data on magnetic tape; and (2) carrying on continuing initial analysis of the data. Storage on magnetic tape will allow the data to be processed later by a large computer system. The initial analysis will assist in real-time interpretation of the test. The minicomputer system for which the program was designed consists of the ALPHA-16 computer, a nine-track read/write magnetic tape unit, a paper tape unit, and a teletype. The program is designed so that field data are input through the teletype unit by using the appropriate letter codes describing the type of data. The computer then stores these raw data on magnetic tape. It also does some simple calculations to update the analysis of the data and stores these results on tape. Also, newly computed information is outputed to the teletype for use by the test operators.

39064 (UCID—17434) **Off-site field guide.** Lake, R.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1977. Contract W-7405-ENG-48. 129p. P 07/MF A01.

The LLL off-site energy programs have different characteristics than those of the testing program. This report presents the organization, the requirements, and the methods for operating off-site.

39065 **Particle segregation in a fluidized bed. Coal gasification process.** Chen, J.L.P.; Keairns, D.L. *Can. J. Chem.;* **53**: No. 4, 395-402(Aug 1975).

Coal gasification involving an agglomerating combustor/gasifier and a devolatilizer/desulfurizer to produce low heating value gas (890 to 1350 kcal/cu m) for power generation was demonstrated for particles of 150 to 2800 μ sizes and 720 to 2800 kg/cu m densities in a 100 mm dia column at up to 6.60 atm, and in a 114 mm dia column at 1 atm. Segregation thus occurred for mixtures of two or more different-size particles (e.g., dolomite) at low pressures (e.g., up to 3.72 atm), and for mixtures of different density particles (e.g., char-dolomite mixtures) at up to 6.09 atm. Particle segregation at low gas velocities reached the steady-state in less than 30 seconds. Over 95 percent separation of agglomerated ash particles may be achieved if the operating gas velocity is close to the minimum fluidizing velocity of the dense particles, i.e., agglomerated ash and spent dolomite. Phase diagrams analogous to those of a solid-liquid system are presented for selecting operating velocities to achieve the desired separation. Diagrams, graphs, and tables are included.

39066 **Laboratory studies of in situ coal gasification.** Steele, R.D.; Nuttall, H.E. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—152).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

An experimental program is underway to simulate the in situ gasification of coal. A laboratory combustion tube together with extensive auxiliary equipment have been designed and assembled. This apparatus has been successfully operated and data have been collected which simulate in situ gasification. This laboratory reactor, its operation and some preliminary data are reported. Problems in interpretation of the data are reported.

39067 **Thermal and structural response evaluation for underground coal gasification.** Advani, S.H.; Lin, Y.T.; Shuck, L.Z. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—7).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Global and micro/macro structural models simulating the Longwall Generator Concept for underground coal gasification (UCG) are formulated for several geometric and loading conditions. Dynamic thermal and stress response solutions are computed for axisymmetric boundary value problems represented by a stationary circular cavity model and an expanding radially propagating circular cavity. Static thermoelastic response solutions are presented for circular and elliptical cylindrical cavities in a homogeneous, isotropic medium and layered media. Considerations pertaining to roof collapse and surface subsidence are discussed. The micro/macro modeling investigations include thermorheological representation of Pittsburgh coal at elevated temperature and studies on thermal crack propagation of coal fissures. Finally, the relevance of stress and temperature profiles, fracture permeabilities, fissure response is discussed in relation to the propagation and stability of the UCG process.

39068 **Modeling of channel formation during underground coal gasification.** Dinsmoor, B.; Galland, J.M.; Edgar, T.F. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—184).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Field trials on underground coal gasification met with mixed results up to 1960. Since that time underground coal gasification systems operated in the U.S.S.R. and U.S. have performed quite successfully. This study was undertaken to identify the key operating variables in underground coal gasification and to determine the underlying reasons for the unsuccessful field tests prior to 1960. A mathematical model of the in situ gasification process has been constructed in order to provide an interpretation of the complicated physicochemical phenomena involved. Since in most field tests a cavity or channel is formed underground between injection and production boreholes, a cylindrical channel in a large bed of coke has been assumed. This channel can be completely open or filled with inert material (overburden). Important factors in the evolution of the channel and its ultimate size have been identified. The results of simulations for a tube 60 meters long and an initial diameter of 0.3 meters are discussed. The occurrence of a long oxidation zone is demonstrated. The phenomenon of oxygen bypassing, where oxygen reacts with combustible components before they can be collected at the outlet, is also evident. This leads to poor gasification yields and excessive gas phase temperatures. The blast velocity and water influx are shown to be two critical variables in the operation of a channel gasifier. As the channel grows, the cold gas efficiency drops, which conforms with field data from previous tests in Great Britain, Alabama, and elsewhere.

39069 **Reactivity and kinetics of sub-bituminous New Mexico coal.** Nuttall, H.E.; Stoddart, W.G.; Chen, W.J. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—95).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Using a custom-designed single-particle reactor and computerized on-line control and monitoring system, an investigation focusing on the devolatilization behavior of New Mexico's subbituminous coal was performed. The study is unique in that rather large (1-in. diameter) single particles of coal were investigated under controlled conditions of temperature, pressure, and gas environment. Also, a real-time mass-spectrometer system was developed and used to continuously monitor gas compositions. The experimental system is described and the results presented. Resulting over-all devolatilization kinetics and appearance kinetics, for selected chemical species, were developed through mathematical modeling, using the experimental data. In addition, several transport properties of the coal were also obtained through the model. The kinetic results from several single-particle tests were compared with literature data for powdered samples. Both a homogeneous nonisothermal devolatilization model and a nonisothermal shrinking core devolatilization model were tested and comparison results presented. Results from this study may be applied to both Lurgi gasifiers and in-situ gasification, noting that these processes treat rather large particles of coal.

39070 **Fuel gases from coal.** New York; MSS Information Corp. (1976). 202p.

Eight articles have been entered individually into EDB and ERA, with two also abstracted in EAPA. Most of the articles deal with coal gasification processes (HYGAS, BI-GAS, COED, SYNTHANE); one paper is a review of coal gasification with comparative evaluation of the presently more promising processes; and one deals with comparative evaluations of alternative energy sources and the possibilities of energy conservation. (LTN)

39071 **Hygas process.** Schora, F. Jr.; Lee, B.S.; Huebler, J. pp 10-29 of In Fuel gases from coal. New York; MSS Information Corp. (1976).

The HYGAS process has been developed based on research started by the Institute of Gas Technology back in 1945. The research and development program, supported initially by the American Gas Association and since 1964 by both the Office of Coal Research of the U.S. Department of the Interior and the American Gas Association, has entered into the large pilot plant stage with the construction of a facility having a capability for producing 45,000 cubic meters of pipeline-quality gas daily. This pilot plant is now

being employed to develop the information necessary for the successful design of a commercial-sized facility. Status of pilot plant developments is discussed. The process is described in detail with respect to control systems, comparative evaluation of methods of hydrogen production, fuel gas purification, methanation, etc.

39072 Coal gasification: a "state-of-the art" review. Berkowitz, N. pp 30-82 of In Fuel gases from coal. New York; MSS Information Corp. (1976).

After reviewing the early work on coal gasification (mostly done in Germany and Britain to get a more flexible chemical feedstock than coal tar), the gasification reactions, heats of reaction and temperature and pressure constraints (temperatures at which the reactions are fast enough, produce more of the desired products, capital cost savings by operating at high pressure and efficiency (with definitions)) are discussed. The necessity of first producing a low-Btu (or synthesis) gas, purifying it and then methanating it (with careful temperature control) to produce high-Btu gas is explained. A number of more promising second-generation gasification processes being developed for commercial application are described briefly, mentioning significant aspects and advantages. Finally, the raw material (coal, water, oxygen, power) and manpower requirements of a large gasification plant, the predicted economics of much plants, and current plans for such plants in the USA are described briefly. The possibilities of producing low-Btu gas in surface plants and by in-situ gasification for power plant fuels are discussed briefly. (LTN)

39073 Coal gasification: evaluating the Bi-Gas SNG process. Hegarty, W.P.; Moody, B.E. pp 83-98 of In Fuel gases from coal. New York; MSS Information Corp. (1976).

A proposed commercial coal gasification plant using the Bituminous Coal Research BI-GAS process is described. While isolated portions of the BI-GAS process have been demonstrated on a pilot plant or commercial basis, there remain certain potential process and mechanical problems which must be resolved in a pilot plant integrating the whole process. These problems are discussed. Various possible improvements of the present design are considered briefly. (LTN)

39074 COED process plus char gasification. Shearer, H.A. pp 99-117 of In Fuel gases from coal. New York; MSS Information Corp. (1976).

A conceptual design and economic study have been conducted for a plant to produce 250 million std. cu. ft./day of pipeline gas, and about 27,000 bbl./stream day of synthetic crude oil, from coal. The plant utilizes the COED coal pyrolysis process along with the M.W. Kellogg Company's molten salt process to gasify COED char. The COED process, developed by the FMC Corp. with support from the Office of Coal Research, is based on multi-stage fluidized-bed pyrolysis of coal to produce oil, gas, and char. The oil is hydrogenated to produce a synthetic crude oil, and the gas can be further processed to produce pipeline gas or hydrogen. The char, amounting to about half of the original coal feed, must be utilized efficiently to avoid a serious economic disability to the process. This design utilizes an existing process to gasify the char and to produce high B.t.u. pipeline gas from the combined raw COED and gasification gases. The Kellogg molten salt process was chosen over other nonproprietary gasification processes because (1) it was considered desirable to be able to feed the 1,600°F COED char as a low-pressure fluidized solid directly to gasification without use of lock-hoppers, and Kellogg's bench-scale work included runs feeding COED char at low pressure, (2) the process uses air instead of oxygen for gasification, (3) the carbon in the char is essentially completely consumed by this process, and (4) it appeared desirable to focus attention on a promising process. The use of the Kellogg process at low pressure results in a lower thermal efficiency than could be achieved at a higher pressure but it avoids the use of lock-hoppers to feed the char into a high pressure region.

39075 Automated monitoring system for an experimental coal gasifier. Fuchs, W.; Berman, M.; Strakey, J.P. Jr.; Ergun, S. pp 164-186 of In Fuel gases from coal. New York; MSS Information Corp. (1976).

A data acquisition system has been developed for the analysis of the performance of an experimental reactor unit for coal gasification. Pertinent data such as gas concentrations, temperatures, and pressures at several locations inside the reactor, and the flow rate of supply gases are collected. An automated calibration procedure of the gas analysis system is included. A minicomputer controls the time sequences of the individual events, allowing a high degree of flexibility. The intervals between two gas analyses can be made as short as 30 sec, the other data can be taken arbitrarily often. The system is suitable for expansion to monitor more physical quantities and to increase the number of observation points inside the reactor.

39076 Clean fluid fuels from coal and wastes. Forney, A.J.; Haynes, W.P. pp 188-193 of In Fuel gases from coal. New York; MSS Information Corp. (1976).

Recent developments in the research on the conversion of coal and wastes to more usable clean fuels (gas and oil) are reviewed. (LTN)

39077 Materials performance in coal pyrolysis and coal oil hydrotreating. Jones, J.F.; McMunn, B.D. pp 194-201 of In Fuel gases from coal. New York; MSS Information Corp. (1976).

Since Incoloy 800 would not normally be used in a commercial plant, a test rack program conducted with the aid of The International Nickel Co., Inc. was initiated to compare selected materials in the hydrotreating atmosphere employed for coal oils. Corrosion rates (metal loss) were determined using original coupon and as-exposed metal loss thickness measurements and the exposure time. This rate reflects metal wastage. Most corrosion rates are low because of the low exposure time; however, the beneficial effects of both chromium and aluminum on sulfidation resistance can be shown by comparing the ferritic stainless steels (400 series), and by comparing alloy 600 to Incoloy alloy 601. The beneficial effect of nickel at levels normally present in austenitic stainless steels (300 series) can be illustrated in comparisons made between ferritic and austenitic stainless steels of similar chromium levels. These data are based on single short time tests and must be treated as such.

39078 (PB—255842) Evaluation of pollution control in fossil fuel conversion processes. Final report, Jun 1972—Jan 1976. Magee, E.M. (Exxon Research and Engineering Co., Linden, N.J. (USA)). Apr 1976. Contract EPA-68-02-0629. 306p. (EXXON/GRU—16DJ.76). NTIS $9.75.

See also PB—249845.

The review gives an overview of work, between June 1972 and January 1976, on various environmental aspects of fossil fuels. Details of this work is presented in 14 reports published during this same period. The details include potential pollutants in fossil fuels; quantities of solid, liquid, and gaseous effluents from coal treatment and conversion to gaseous and liquid fuels; and an analytical test plan for coal conversion systems. The overview report discusses commonality and differences in the reviewed processes with emphasis on factors which might affect the environment when the processes are in commercial use. Due to the lack of a sufficient data base, data and research and development needs are also addressed. (GRA)

39079 Methanation process utilizing split cold gas recycle. Tajbl, D.G.; Lee, B.S.; Schora, F.C. Jr.; Lam, H.W. (to Energy Research and Development Administration). US Patent 3,967,936. 6 Jul 1976. Filed date 2 Jan 1975. 6p.

PAT-APPL-538,061.

In the methanation of feed gas comprising carbon monoxide and hydrogen in multiple stages, the feed gas, cold recycle gas, and hot product gas is mixed in such proportions that the mixture is at a temperature sufficiently high to avoid carbonyl formation and to initiate the reaction and, so that upon complete reaction of the carbon monoxide and hydrogen, an excessive adiabatic temperature will not be reached. Catalyst damage by high or low temperatures is thereby avoided with a process that utilizes extraordinarily low recycle ratios and a minimum of investment in operating costs. 3 claims, 1 figure.

39080 Process for reducing sulfur in coal char. Gasior, S.J.; Forney, A.J.; Haynes, W.P.; Kenny, R.F. (to Energy Research and Development Administration). US Patent 3,970,434. 20 Jul 1976. Filed date 7 Oct 1974. 4p.

PAT-APPL-512,819.

Coal is gasified in the presence of a small but effective amount of alkaline earth oxide, hydroxide, or carbonate to yield a char fraction depleted in sulfur. Gases produced during the reaction are enriched in sulfur compounds and the alkaline earth compound remains in the char fraction as an alkaline earth oxide. The char is suitable for fuel use, as in a power plant, and during combustion of the char the alkaline earth oxide reacts with at least a portion of the sulfur oxides produced from the residual sulfur contained in the char to further lower the sulfur content of the combustion gases. 3 claims.

39081 Heat pipe methanator. Ranken, W.A.; Kemme, J.E. (to Energy Research and Development Administration). US Patent 3,971,634. 27 Jul 1976. Filed date 25 Apr 1975. 6p.

PAT-APPL-571,655.

A heat pipe methanator for converting coal gas to methane is described. Gravity return heat pipes are employed to remove the heat of reaction from the methanation-promoting catalyst, transmitting a portion of this heat to an incoming gas pre-heat section and delivering the remainder to a steam generating heat exchanger. 12 claims, 6 figures.

39082 Agglomerating combustor-gasifier method and apparatus for coal gasification. Chen, J.L.P.; Archer, D.H. (to Energy Research and Development Administration). US Patent 3,981,690. 21 Sep 1976. Filed date 15 Jan 1975. 8p.

PAT-APPL-541,376.

A method and apparatus are described for gasifying coal wherein the gasification takes place in a spout fluid bed at a pressure

of about 10 to 30 atmospheres and a temperature of about 1800 to 2200°F and wherein the configuration of the apparatus and the manner of introduction of gases for combustion and fluidization is such that agglomerated ash can be withdrawn from the bottom of the apparatus and gas containing very low dust loading is produced. The gasification reaction is self-sustaining through the burning of a stoichiometric amount of coal with air in the lower part of the apparatus to form the spout within the fluid bed. The method and apparatus are particularly suitable for gasifying coarse coal particles. 11 claims, 4 figures.

39083 Gas producer plants. Saha, M.; Pillai, P.C. (Otto India Ltd., Calcutta). *J. Inst. Eng. (India), Chem. Eng. Div.;* **57**: 36-38(Oct 1976).

The energy crisis arising out of very high cost of petroleum has focussed the attention on search for an alternative fuel, specially for heating purposes. Considering the high cost and difficulty in coke availability compared to coal, the use of the latter has to be preferred wherever possible. In the double stage gas producer plants, coal can be used and this process ensures not only a gas of comparatively high calorific value but also a wide choice in the selection of various grades of coal. Hot gas containing tar vapor, or tar-free hot gas, or tar and dust-free clean gas can be produced depending on the requirement. The technical know-how is available indigenously and the entire plant can be designed, constructed and commissioned completely with indigenous resources without any payment in foreign exchange.

39084 New technique for utilization of high ash and high sulfur coals. Chowdhury, N.K. (Development Consultants Ltd., Calcutta). *J. Inst. Eng. (India), Chem. Eng. Div.;* **57**: 42-45(Oct 1976).

Coal remaining the principal source of energy, its consumption is expected to double the present rate by the turn of the century. Notwithstanding our large reserves, our resources of good quality metallurgical coal are limited and have to be conserved for obvious reasons that the abundant high ash content poor quality coal has to be used for power generation. But use of low grade coal has many problems such as atmospheric pollution, accelerated wear and tear of steam generating units, cost control, etc. These problems have been discussed in brief in this paper with suggested remedies.

39085 Producer gas and its application. Ramakrishnan, N.N.; Parlikar, R.N.; Vaidyeswaran, R. (Regional Research Lab., Hyderabad, India). *J. Inst. Eng. (India), Chem. Eng. Div.;* **57**: 50-52(Oct 1976).

The importance of producer gas as a substitute for furnace oil is discussed. The various types of producers and the fuels suitable for producer gas, availability of equipment, and the limitations of producer gas are also discussed. The cost of the producer gas is compared with that of furnace oil.

39086 Techno-economic aspect of gas production in producer gas plant based on coal and coke. Gupta, R.S.; Bose, B. (Kopper India Pvt Ltd., Calcutta). *J. Inst. Eng. (India), Chem. Eng. Div.;* **57**: 59-64(Oct 1976).

The technology of producer gas has been revived after the oil crisis. Technically it is a proven method by which the energy required can be achieved from the gas producers at 50% cost in comparison to oil today. The payback period of the plant is 24 to 30 months only. It is recommended that hot gas should be used where gas cleaning is not necessary and tar can be burnt along with the gases. For sophisticated uses cold and clean gas should be used.

39087 Gasification of carbonaceous solids. Coates, R.L. (to Energy Research and Development Administration). US Patent 3,988,123. 26 Oct 1976. Filed date 15 Aug 1975. 8p.

PAT-APPL-605,369.

A process and apparatus are described for converting coal and other carbonaceous solids to an intermediate heating value fuel gas or to a synthesis gas. A stream of entrained pulverized coal is fed into the combustion stage of a three-stage gasifier along with a mixture of oxygen and steam at selected pressure and temperature. The products of the combustion stage pass into the second or quench stage where they are partially cooled and further reacted with water and/or steam. Ash is solidified into small particles and the formation of soot is suppressed by water/steam injections in the quench stage. The design of the quench stage prevents slag from solidifying on the walls. The products from the quench stage pass directly into a heat recovery stage where the products pass through the tube, or tubes, of a single-pass, shell and tube heat exchanger and steam is generated on the shell side and utilized for steam feed requirements of the process. 8 claims, 1 figure.

39088 Gasification of Hat Creek coal. Chan, E.M.; Papic, M.M. (British Columbia Research, Vancouver). *Can. J. Chem. Eng.;* **54**: No. 6, 645-646(Dec 1976).

Hat Creek coal is subbituminous coal with a caloric value of about 14000 kJ/kg. A sample was devolatilized in nitrogen at 800°C and the kinetics of gasification of the residual char with steam was investigated. It is concluded that Hat Creek coal can be successfully gasified by steam to produce a gas containing H_2, CO, and CO_2. The char—steam reaction is slow and reaction rate controlled. (DLC)

39089 Method for control of subsurface coal gasification. Komar, C.A. (to Energy Research and Development Administration). US Patent 3,997,005. 14 Dec 1976. Filed date 23 Oct 1975. 6p.

PAT-APPL-625,273.

The burn front in an in-situ underground coal gasification operation is controlled by utilizing at least two parallel groups of vertical boreholes disposed in the coalbed at spaced-apart locations in planes orthogonal to the plane of maximum permeability in the coalbed. The combustion of the coal is initiated in the coalbed adjacent to one group of the boreholes to establish a combustion zone extending across the group while the pressure of the combustion supporting gas mixture and/or the combustion products is regulated at each well head by valving to control the burn rate and maintain a uniform propagation of the burn front between the spaced-apart hole groups to gasify virtually all the coal lying therebetween. 3 claims, 1 figure.

LIQUEFACTION

REFER ALSO TO CITATION(S) 39051, 39055, 39059, 39060, 39061, 39062, 39070, 39074, 39076, 39077, 39078, 39106

39090 (ANL—77-6) Coal liquefaction support studies. Task I. Heat of reaction of hydrogen with coal slurries. Task II. Heat transfer coefficient. Quarterly report for October—December 1976. Fischer, J.; Lo, R.; Mulcahey, T.; Fredrickson, D.; Cannon, T.; Jonke, A. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-ENG-38. 16p. P 05/MF A01.

This work is in support of the development of processes (such as the synthoil process) for converting coal to a liquid fuel that has a low sulfur content and is suitable for use in power production. In the synthoil process for converting coal to a low-sulfur fuel oil, coal is liquefied and hydrodesulfurized in a turbulent-flow, catalytic packed-bed reactor. A slurry of coal in recycled oil is reacted with hydrogen at 450°C and 2000—4000 psi in the presence of Co—Mo/SiO_2—Al_2O_3 catalyst. Turbulent flow of fluid prevents the coal's mineral matter from settling and plugging the reactor. In the ½ ton per day pilot plant at PERC, the gross liquid product is centrifuged to remove unreacted solids, producing a low-sulfur, low-ash liquid fuel. The heat of reaction of coal-oil slurries with hydrogen will be determined in the presence and absence of catalysts at 2000—4000 psi and 400—475°C, using a calorimeter. Calorimeter construction is complete, and performance evaluation and calibration have been started. The coefficients of heat transfer from synthoil reactor fluids to heat exchangers will be determined in the following ranges of conditions: pressures of 2000—4000 psi and temperatures to 465°C. The test unit has been installed. Acceptance testing will be done during January 1977.

39091 (EPRI-AF—305) Application of advanced materials and fabrication technology to let-down valves for coal liquefaction systems. Final report. Mueller, J.J. (Battelle Columbus Labs., Ohio (USA)). Jan 1977. 183p. P 09/MF A01.

A program entitled "Application of Advanced Materials and Fabrication Technology to Letdown Valves," which covered a period of performance from May 1, 1975 through July 31, 1976 is summarized. The program included: (1) a survey of liquefaction processes and related wear problems, with particular emphasis on letdown valves, and (2) an experimental program of materials fabrication and wear test evaluation. Results of a literature survey show the existence of only a limited understanding of the mechanisms involved in wear processes in liquid systems and at elevated temperatures. No experimental work on coal-derived abrasive oil slurries was found. An experimental wear-test system which employs an ash-containing coal-derived slurry as the eroding medium is described. The test consisted of forcing slurry heated to 149°C through an orifice by an argon overpressure of 2000 psi and directing the impinging jet at an angle of 45° to the test surface. Measurable erosion was produced within practical short test times without higher temperatures or the addition of hydrogen or hydrogen sulfide. It was found that the wear produced in cemented carbides was similar to that observed in actual worn valve-trim components. A group of nine different cemented carbides and a group of twelve different grades or types of ceramics were evaluated. All showed measurable wear within a 2-½ h test period. Among the cemented carbides the K703 grade with cobalt-chromium binder and a specially prepared low-cobalt-content material yielded the lowest values with eroded depths of 7.0 and 7.6 μm, respectively. The highest value of wear depth among the cemented carbides was 74.9 μm. The ceramics were generally less wear resistant under the same test conditions. A special high density grade of B_4C performed best with an erosion depth of 9.6 μm. Silicon carbide was notedly the poorest performer.

39092 (FE—2007-25) **Filtration process and equipment studies for coal liquefaction processes. Quarterly report, September—November 1976.** Smith, G.R.S.; Martin, P.C. (Johns-Manville Sales Corp., Denver, Colo. (USA)). 16 Dec 1976. Contract EX-76-C-01-2007. 30p. P 03/MF A01.

Record flow rates for Tacoma Filter Feed in the order of 400 pounds/square foot of total filter area/hour were obtained. These rates were obtained at 600°F and 40 psi differential pressure. The highest previous rate of 313 pounds/square foot/hour was obtained under similar conditions, but at 509°F temperature. As a result of having studied Tacoma Filter Feed in great detail, an experimental design was worked out to characterize filtration properties of other liquids in a minimum amount of time. Using this experimental design, filtration properties of uncentrifuged Synthoil and Wilsonville Filter Feed were determined. Maximum rates for Tacoma, Wilsonville, and Synthoil materials were in the order of 400, 460, and 270 pounds/square foot/hour, respectively, at 600°F, 35 psid, and 5 second immersions of the test leaf. A series of runs was made during which the knife was not advanced to determine the amount of leakage, if any, that might occur around the edge of the precoat. After eighteen 5 second immersions during which a $^3/_{32}$-inch cake was allowed to build up on the precoat, the filtration rate was 45 pounds/square foot/hour. Tests run on two grades of precoat material of different permeabilities indicate that lower knife cuts can be made with the lower permeability material without sacrificing rate.

39093 (FE—2031-6) **Chemistry and structure of coal-derived asphaltenes: Phase II. Quarterly progress report, October—December 1976.** Yen, T.F. (University of Southern California, Los Angeles (USA)). 1976. Contract E(49-18)-2031-PHA-2. 34p. Dep. NTIS $4.00.

Plots of H/C atomic ratios versus aromaticity, f/sub a/, for coal liquid fractions suggest that aromatization is responsible for the highly aromatic nature of the carbene and carboid fractions, and that hydrogenation of intermediate fractions tends to reduce f/sub a/ values to that of chainlike saturated species. Infrared analysis of asphaltenes and asphaltene chromatography fractions confirms the generality that phenolic OH is found in both the neutral and basic asphaltene fractions but predominates in the neutral fraction. Proton NMR structural analyses indicates that coal asphaltenes are highly aromatic species, moderately substituted with short chain or naphthenic groups, and condensed in kata-systems. Preliminary VPO molecular weight studies indicate that coal asphaltenes are progressively associated in benzene, but probably unassociated or only slightly associated in tetrahydrofuran over the concentration range 4 to 40 g/l. Asphaltene-iodine donor-acceptor complexes have been synthesized which afford charge-transfer ultraviolet-visible absorption bands. Conductivity and x-ray diffraction studies of these complexes do not support an ordered asphaltene-iodine layered structure. Silylation of asphaltenes indicates that essentially all the oxygen in SRC produced asphaltenes is phenolic oxygen. Asphaltenes produced in staged pyrolysis or catalytic hydrogenation appear to have only about 50 percent of the oxygen present as phenolic oxygen.

39094 (FE—2367-2) **Effects of solvent characteristics on Wyodak coal liquefaction. Calendar year report for the period May—September 1976.** Silver, H.F.; Hurturbise, R.J. (Wyoming Univ., Laramie (USA)). 15 Oct 1976. Contract EX-76-S-01-2367. 3p. P 02/MF A01.

The investigation of the effects of solvent characteristics on Wyodak coal liquefaction was directed toward developing experimental procedures. A Wyodak coal-derived recycle solvent, received from the Wilsonville SRC plant, will be used as a reference solvent. Preliminary analyses have indicated the possible presence of tetralin and napthalene in this solvent. The Wilsonville solvent has been hydrogenated at two different severity levels over a Co—Mo catalyst. In addition, liquefaction experiments have been initiated using approximately 150 grams of Wyodak coal received from Wilsonville in approximately 300 grams of the Wilsonville Wyodak coal-derived solvent. Conversions measured, using procedures developed at Hydrocarbon Research Inc., Trenton, N. J., were much lower than observed at Wilsonville. Analysis of the preliminary results obtained indicate that increasing reaction time beyond twenty minutes has little effect on increasing the extent of Wyodak coal liquefaction. However, significant increases in conversion are obtained by increasing hydrogen pressure. These results are indicative of mass transfer limitations from hydrogen in gas bubbles to the coal liquid. Engineers at Autoclave Engineers, Inc. believe that the mass transfer characteristics of the reactor used in this program can be improved. An order has therefore been placed with Autoclave for an improved reactor agitator. Coal liquefaction runs will resume when the reactor modifications have been completed.

39095 **Group composition of liquid coal hydrogenation products determined by adsorption—elution chromatography.** Mandelbaum, M. (Inst. of Carbon Chemistry, Tychy, Poland). *Koks, Smola, Gaz;* **22**: No. 1, 17-20(Jan 1977). (In Polish).

An attempt is presented of adapting the PN-72/C-04025 standard "Determination of the hydrocarbon group composition by the method of elution chromatography," binding for petroleum products, to determining the group composition of liquid coal hydrogenation products. New parameters are given as to how conduct separation and a mode of proceeding is proposed. Results obtained from separating liquid coal hydrogenation products out of low temperature tar and heavy ends hydrogenation of the liquid hydrogenation product are discussed.

39096 **Treating coal liquefaction product oil.** Goldberger, W.M.; Faulkner, B.P. (to Battelle Memorial Inst.). US Patent 4,012,314. 15 Mar 1977. Filed date 5 Sep 1975. 12p.

Methods are described of treating an oil derived by liquefaction of coal particles to separate unreacted solid matter therefrom and collect it in water or other aqueous medium, which comprise controlling the specific gravity of the oil to provide an oleaginous fluid having a substantially lower specific gravity than the aqueous medium, as by mixing the oil with a liquid that is miscible therewith and has a lower specific gravity, or by controlling the temperature of the oil, or both; contacting the fluid with the aqueous medium; moving the fluid in such a manner as to provide a substantial acceleration thereto in a direction to drive most of the solid matter away from the fluid and into the aqueous medium as by moving the fluid in a swirling path around an axis while maintaining a portion of the aqueous medium around at least a portion of the periphery of the path; and separating the aqueous medium with the solid matter contained therein from the fluid. Typically a layer of the aqueous medium is formed with a layer of the fluid contiguous thereto, and the fluid layer is accelerated (as by centrifuging) to generate a force which acts to drive the particles from the fluid layer toward the aqueous layer, or the layers may be formed by injecting the fluid and the aqueous medium through separate, adjacent passageways into a cyclone separator whereby the layers are accelerated. 20 claims, 4 figures.

PYROLYSIS AND CRACKING

REFER ALSO TO CITATION(S) 39058, 39099

39097 **Khimiya skorostanogo piroliza burykh i kamennykh uglei. (Chemistry of the rapid pyrolysis of lignite and bituminous coal).** Loskutova, E.N. Novosibirsk, USSR; Izdatel'stvo Nauka (1976). 120p.

The high-speed pyrolysis of brown coals and bituminous coals was investigated. The influence of petrographic and chemical components on yield and composition of products was shown. The composition of coal extracts, tars, and crude benzene was determined by chromatography. The value of the liquid phase formed and changes in its composition under the influence of thickening in the process of coke formation was studied.

SOLVENT EXTRACTION

REFER ALSO TO CITATION(S) 39093

39098 **Mixer assures consistent feed to synthetic fuel reactor. Powdered coal/solvent slurry is readied in seconds.** Heher, B. (Univ. of North Dakota, Grand Forks); Gaines, A. *Chem. Process. (Chicago);* **40**: No. 1, 112-113(Jan 1977).

Poor liquids/solids mixing was hampering the development of a process for the production of low-sulfur solvent-refined lignite by liquefaction of lignite in a high-pressure reactor. As a result, the vertical mixing system was replaced with a horizontal, continuous mixer that features 2-forward and 1-reverse angle paddle blades in each mixing section. The slurry preparation operation has been virtually trouble-free since the horizontal paddle-blade mixer was installed. (EJH)

BY-PRODUCTS

39099 **Chemicals from coal.** Bose, P.K. (Indian Oxygen Ltd., Calcutta). *J. Inst. Eng. (India), Chem. Eng. Div.;* **57**: 6-10(Oct 1976).

Destructive distillation of coal can supply basic raw materials for many essential industries from dyes, drugs, pesticides, elastomer, to modern plastics. With increasing preference for basic oxygen steel-making coal tar, a by-product from the coke oven plant, is not likely to be used as a fuel in the open hearth furnace. Even coke oven gas will be surplus after meeting the fuel balance of the captive steel plants. The tar, benzol, phenol products and also the coke oven gas from the steel plants could thus be utilized as feedstock for various chemicals. The separation of coke oven gas by cryogenic process would give methane, hydrogen, carbon monoxide, ethylene as starting materials for various process industries. The viable organic chemical industry based on carbon monoxide as an inexpensive building block could be developed by recovering carbon monoxide from synthesis gas, methanol plant of gases, blast furnace top gas, waste gas from LD converters etc. by suitable selective washing

process of CO. The recovery of pyridine, alkyl pyridines, quinolines, isoquinolines, gamma picoline as by-products from tar distillation plant could also form raw materials for a viable pharmaceutical industry in the country which is now based mostly on petrochemical feedstock. The paper also highlights the present status of the industry in India, the type of projects already taken up in the fertilizer plant, carbonization plant, gasification plant and the contribution in field of R and D made by the various research institutes, design consulting firms, Lacuna in the development of coal chemical industry have been pointed out and it is suggested that a central agency be established for promoting coal based chemical industry by utilizing the existing facilities and projects likely to come in the future using coal as feedstock under the State/Central sectors.

39100 Coal chemicals as primary feedstock for pharmaceutical industry. Chakrabarty, M.M.; Lahiri, C.R.; Raha, T.K. (Univ., Calcutta). *J. Inst. Eng. (India), Chem. Eng. Div.;* **57**: 14-19(Oct 1976).

Development of a self-sustained pharmaceutical industry is vitally concerned with the expansion of the national health service. One of the factors for self-reliance is the ready availability of adequate quantity of basic raw materials. At present petrochemicals is the favored feedstock for the pharmaceutical industry. The recent unprecedented rise in the petroleum products demands review of the situation. Potentialities of coal chemicals as starting material for pharmaceutical industry have so far received scanty attention. The potential of coal-based chemical industries is indicated. The abundance of the indigenous coal, its flexible processing techniques, its contribution to the national economy by saving scarce foreign exchange and harnessing more indigenous resources along with other intangible benefits makes coal an ideally suitable feedstock for chemical industry of which pharmaceutical industry is a part.

39101 Coal to fertilizer. Ghosh, B.B. (Indian Investment Centre, Calcutta). *J. Inst. Eng. (India), Chem. Eng. Div.;* **57**: 25-26(Oct 1976).

The demand for nitrogenous fertilizers in the world is more than the other types, because crops are more responsive to their application. Nitrogenous fertilizers are mainly ammonium sulfate, ammonium nitrate, and urea which are produced from ammonia. The raw materials which can be used for the production of synthetic ammonia are wood, lignite, coal, electrolytic hydrogen, coke oven gas, LP gas, refinery gas, naphtha, and fuel oil. Of these coal, natural gas and petroleum products based plants are more common because of their easy availability and the economics of the processes involved. Availability of natural gas in India being low, the paper discussed briefly the processes for the manufacture of synthetic gas from coal and petroleum-based feedstocks. As the availability of crude oil is uncertain, the price has increased 2 to 3 times the price about two years ago and it is expected that prices will further increase, it is suggested that a detailed study should be made of the economics of production of fertilizers, based on coal and oil.

39102 Manufacture of textile dyes from coal chemicals. Bose, B. *J. Inst. Eng. (India), Chem. Eng. Div.;* **57**: 39-41(Oct 1976).

The potential of chemical industries based on available coal chemicals is quite encouraging in West Bengal. Dye industry is one such industry where the coal chemical can find multitude of usage. The author discusses in detail the possibility of manufacture of textile dyes from the important coal-based chemicals, that is phthalic anhydride and anthracene. As coal-based chemicals are available in the Eastern region, these can be suitably converted to dye products. The supply of dye products is inadequate in the Eastern region which has to depend on the Western region. It is expected that if the coal chemical-based dye industry be properly encouraged then the demand in the country can be ultimately met.

39103 Pharmaceutical industries based on coal chemicals. Bose, A.N. (Technical and Industrial Consultants, Calcutta). *J. Inst. Eng. (India), Chem. Eng. Div.;* **57**: 46-49(Oct 1976).

Consequent to the tremendous increase in price of crude petroleum, coal chemicals derived from by-product coke ovens have regained their former importance as raw materials for the pharmaceutical industries. The present situation demands maximizing production thereof along with other vital basic products such as pyridine and picoline. Scanty reserves of coking coal and their fast depletion are, however, likely to compel exploration of the possibility of replacement of hard coke by formed coke manufactured from noncoking coals for iron making. Intensive research, therefore, is suggested to ensure supply of vital raw materials for the pharmaceutical industries in the event of India being obliged to ultimately fall back on formed coke.

PROPERTIES

REFER ALSO TO CITATION(S) 39044, 39046, 39069, 39093, 39095, 39175, 39691, 39937

39104 (BERC—0020-7) Mass spectrometric analytical services and research activities to support coal-liquid characterization research. Quarterly report, December 9, 1976—March 8, 1977. Scheppele, S.E. (Oklahoma State Univ., Stillwater (USA). Dept. of Chemistry). 17 Mar 1977. Contract EY-76-S-02-0020. 13p. P 02/MF A01.

Field-ionization relative sensitivities were determined at an ion-source temperature of ca. 270°C for 16 saturates and naphthenes in 18 mixtures containing only saturated and naphthenic hydrocarbons, and for 14 saturates and naphthenes in 5 mixtures containing aromatic hydrocarbons. Variations in the relative gram sensitivities for 6 saturates in the presence of ethylbenzene (3 mixtures) and in the absence of ethylbenzene (2 mixtures) at an ion-source temperature of ca. 100°C were compared with literature values for similar mixture compositions determined at an ion-source temperature of ca. 120°C.

39105 (COO—2898-9) Study of oxygen: stoichiometry and analysis of coal, lignite, coke and their derivatives. Progress report. (North Dakota State Univ., Fargo (USA). Dept. of Chemistry). 8 Nov 1976. Contract EY-76-S-02-2989. 8p. Dep. NTIS $3.50.

After discussing the importance of oxygen studies in coal research, the difficulties of determination of oxygen in coal and its by-products are considered. Although the difficulties of determination are great, there are advantages, if this can be done, of determining more precise chemical composition values of coal than are obtained by the usual method of "oxygen by difference." On the basis of the results a more precise method is suggested, i.e., "Oxygen by difference minus cations in ash." For general analytical work the use of oxygen as 46 percent of the ash is suggested as giving a more accurate value with the usual methods without additional work. The results are based on analyses of 104 samples of coal, coal liquids, lignite and asphaltenes and illustrated by tables. The determination of organic oxygen by determining both low temperature ash and high temperature ash is discussed briefly. (LTN)

39106 (PERC/RI—77/3) Chromatographic characterization of coal liquefaction products. Schweighardt, F.K. (Energy Research and Development Administration, Pittsburgh, Pa. (USA). Pittsburgh Energy Research Center). Feb 1977. 16p. Dep. NTIS $3.50.

The experimental details of a number of reports dealing with adsorption chromatography, solvent separation, thin-layer chromatography/electrophoresis, and acid/base separation of asphaltenes and coal liquefaction oils prepared by the SYNTHOIL process are summarized. The methods and techniques described here are the result of preliminary investigations to find the best approach to a complex problem of characterization.

39107 (PERC/RI—77/6) Decomposition characteristics of phenol under SYNTHANE gasifier conditions. Fillo, J.P.; Massey, M.J.; Strakey, J.P.; Nakles, D.V.; Haynes, W.P. (Energy Research and Development Administration, Pittsburgh, Pa. (USA). Pittsburgh Energy Research Center). Apr 1977. 47p. P 03/MF A01.

Major conclusions to be drawn from this study regarding the decomposition characteristics of phenol are: the rate-determining step in the decomposition of phenol appears to be the initial thermal decomposition of the aromatic molecule; hydrogen partial pressure in the reactor does not affect the extent of phenol decomposition but is important in determining the subsequent decomposition products of phenol; reaction gas composition remains stable over the range of conditions where phenol decomposition was studied; and solid char surface appears to substantially increase the high temperature vapor phase decomposition of phenol without causing methane decomposition. The first and second conclusions are consistent with observed data for the decomposition of unsubstituted aromatic compounds for which a proportionality between experimental activation energy and calculated delocalization energy has been indicated. This may suggest a rationale for hypothesizing the reactivity of other phenolic compounds present in SYNTHANE gasifier aqueous effluents, relative to phenol. Conclusions three and four, coupled with knowledge of the extent of observed phenol decomposition, provide a rationale for explaining decreases in effluent phenol production with increased depth of coal injection, as previously reported for the SYNTHANE PDU. These data also suggest that significant decreases in phenol production should be seen in the 72 TPD SYNTHANE pilot plant. Finally, these data suggest that a viable alternative may exist to present largescale treatment of coal gasifier effluents. The susceptibility of phenol, and other hydrocarbons (e.g., tars, oils) produced during coal gasification, to thermal decomposition makes thermal treatment of raw gasifier effluents a reasonable possibility.

39108 (NP-tr—1967) Prediction of coke quality on the basis of petrographic features. Ammosov, I.I.; Eremin, I.E.; Grechishnikov, M.B. Translated from *Khim. Tverd. Topl.;* No. 6, 81-90(1973). 15p. U 02/MF A01.

In 1972 specialists from fourteen countries undertook to study the petrographic features of three samples of French coal and mixtures composed of these, on the initiative of the International Coal Petrology Committee, for the object of analyzing the possibility and evaluating the reliability of any prediction that might be made on the quality of the coke taking the quantitative petrographic description of the coal as a basis. The results of this research are

described, and predictions of the mechanical strength of the coke and the comparison of this prediction with the actual strength obtained when the coals were carbonized are made.

39109 (NP-tr—1963) **Automation of coal petrographic analysis.** Kojima, K. Translated from *Nenryo Kyokai-shi;* **53**: No. 12, 1073-1081(1974). 24p. U 02/MF A01.

Coal petrographic analysis by optical microscopy is universally accepted as a useful technique for quantitative evaluation of the coking properties of coking coals. Owing to the difficulty of the analytical procedure, however, the method has still not come into general use. Automation has been examined as a means of resolving this difficulty and some measure of success has been obtained.

39110 **Tekhnologiya obogashcheniya uglei. (Technology of coal enrichment).** Fomenko, T.G.; Butovetskii, V.S.; Pogartseva, E.M. Moscow; Nedra (1976). 304p.

Methods of conducting analyses and calculation of enrichment of coals are discussed. Estimates were made of the main parameters of enrichment. Designs of machines, recommendations for their exploitation and regulation, testing of coals and products of enrichment, and estimates of indexes of enrichment are considered.

39111 **Diffusion of methane through coal.** Thimons, E.D.; Kissell, F.N. pp 10-28 of In Coal. II. Current advances in coal chemistry and mining techniques. New York; MSS Information Corporation (1976).

Both methane and helium flow through solid coal by Knudsen diffusion, even at relatively high pressures. Knudsen permeabilities were determined for samples of Pittsburgh, Pocahontas No. 3, and Oklahoma Hartshorne coals. The average permeability for dry methane was 1.3 x 10^{-6} cm^2/s for Pittsburgh coal, 20 x 10^{-6} for Pocahontas No. 3 coal, and 13.8 x 10^{-6} for Oklahoma Hartshorne coal. A molecular-sieve effect exists for methane in all three coals examined and it is very strong in Pittsburgh coal. If the methane is saturated with water vapor the permeability decreases by a factor of 3 to 25, depending on the coal. The Knudsen permeability of solid coal discs seems to bear no relation to coalbed permeability. Lag-time measurements indicate systems of both larger and finer pores and the presence of blind pores. This effect is again more pronounced in the Pittsburgh coal.

39112 **Some measurements of the $^{12}C/^{13}C$-ratio in methane or ethane desorbed from hard coal or released by pyrolysis.** Friedrich, H.U.; Juntgen, H. pp 29-35 of In Coal. II. Current advances in coal chemistry and mining techniques. New York; MSS Information Corporation (1976).

A method permitting the release of most of the gases adsorbed physically or bound chemically in coal is described along with how to prepare them for gas chromatographic analyses and for determining the $^{12}C/^{13}C$-ratio by mass spectrometry. The absorbed gas is recovered from fresh coal samples in three fractions; the coal remaining is treated in the same gas-tight vessel. First, the gas desorbed from the granular coal sample is pumped off and collected. The second fraction is the gas desorbed and sucked off during the grinding of the coal. The third fraction is obtained by subsequent heating of the coal to about 120°C. Finally, the gases released by pyrolysis at low rates of heating are collected. All gas fractions are completely analyzed by means of a gas chromatograph. A second gas chromatograph is used to separate from the different gas fractions the methane and ethane contained in them and both gases are oxidized separately to CO_2 in a combustion apparatus. All of the CO_2 obtained in this way is separated, and the $^{12}C/^{13}C$-ratio is determined and compared with a standard, using a mass spectrometer with a double inlet system and two collectors.

39113 **Method for the determination of reactivity of coke.** Banerjee, N.G.; Mitra, P.K.; Raja, K.; As, D.K. (Cent. Fuel. Res. Inst., Dhanbad, India). *J. Mines, Met. Fuels;* **24**: No. 6, 206-209(Jun 1976).

A method developed to determine the reactivity of coke/char toward carbon dioxide is described. This new test procedure overcomes some shortcomings of conventional methods such as the U.K.'s standardized FRS method. The rate of reaction between CO_2 and carbon is found to be dependent on the rate of CO_2 flow through the coke bed. Using this procedure, the reactivity of 13 samples of coke (from different coal ranks), chars and briquettes were determined. 16 refs.

39114 **Dependences between properties of coals, coal blends, and coke.** Heilpern, S. (Instytut Chemicznej Przerobki Wegla, Zabrze, Poland); Kaziszyn, I.; Zarembinska, J.; Postrzednik, S. *Koks, Smola, Gaz;* **21**: No. 12, 345-352(Dec 1976). (In Polish).

Investigations were made on charge coals representative for home conditions with the aim of determining the degree of additivity for selected assessment indices of raw material quality. A functional dependence was found between strength indices of coke and those characterizing the coal blend on changing the correlation coefficient r^2 from 0.70 to 0.48.

39115 **Utility of pulse nuclear magnetic resonance in studying protons in coals.** Gerstein, B.C.; Chow, C.; Pembleton, R.G.; Wilson, R.C. (Iowa State Univ., Ames). *J. Phys. Chem.;* **81**: No. 6, 565-570(24 Mar 1977).

ESR, pulse NMR, and multiple pulse NMR were used to study free radical concentrations, and the extent to which protons in coals may be characterized by damping constants under specific radio-frequency pulse sequences in two Virginia vitrains, three Iowa vitrains, and selected model compounds. NMR pulse techniques were used to determine damping constants associated with proton spin—spin and spin—lattice relaxation. Multiple pulse line narrowing experiments were capable of narrowing the proton line width from roughly 30 kHz in all coals to roughly 700 Hz. Comparison of results on coals with pulse and multiple pulse measurements on the model compounds naphthalene, 2-methylnaphthalene, 4,4'-bismethylbenzophenone, m-tolylacetic acid, polystyrene, polyethylene, and polybutadiene indicated: (a) roughly 400 Hz of the residual proton line width in the coals under multiple pulse line narrowing experiments is due to free radical electron spin—nuclear spin dipolar coupling, (b) there is not a simple relation between spin—spin damping constants in coals, and aliphatic/aromatic proton ratios, and (c) resolution into aromatic and aliphatic protons will require removal of interproton dipolar interactions, proton chemical shift anisotropies, and electron—proton interactions by a combination of multiple pulse line narrowing experiments and magic angle rotation.

WASTE MANAGEMENT

39116 (EPRI-FP—327) **Guidelines for the design of mist eliminators for lime/limestone scrubbing systems. Final report.** Conkle, H.N.; Rosenberg, H.S.; DiNovo, S.T. (Battelle Columbus Labs., Ohio (USA)). Dec 1976. 121p. P 06/MF A01.

The current state-of-the-art of mist eliminator design for lime and limestone flue gas desulfurization (FGD) scrubbing systems is presented. Chevron and baffle type mist eliminators were treated extensively while radial vane, radial baffle, and electrostatic precipitator mist eliminators were covered to a lesser degree. Background information covered collection, reentrainment and mist eliminator failure mechanisms. Design factors affecting the performance, cost, and collection efficiency such as mist eliminator construction, configuration, and wash systems were also presented. Summarized in extensive tables are (1) scrubber background information, (2) mist eliminator design specifications, and (3) mist eliminator wash system specifications for all operational lime and limestone FGD systems in the United States.

39117 (MERC/TPR—77/1) **Sulfur removal in fluidized-bed combustion.** Little, J.L. (Energy Research and Development Administration, Morgantown, W.Va. (USA). Morgantown Energy Research Center). Feb 1977. 39p. P 03/MF A01.

Equilibrium partial pressures of sulfur dioxide over some metal oxides were calculated in order to qualitatively assess the ability of the oxides to absorb SO_2. At higher temperatures, CaO, SrO, MgO, Li_2O, and Na_2O were found to be efficient absorbers, while CoO, CdO, La_2O_3, MgO, and Mn_2O_3 were found to be borderline absorbers. Decomposition of Li_2SO_4, $MgSO_4$, $MnSO_4$, $La_2(SO_4)_3$, and $CoSO_4$ was studied at higher temperatures. In the range of fluidized-bed combustor operating conditions, Li_2SO_4 is very stable while $MgSO_4$ and $La_2(SO_4)_3$ are fairly stable. However, $MnSO_4$ and $CoSO_4$ are very unstable. The presence of SO_2 in the gas stream retards the decomposition of $MgSO_4$, $MnSO_4$, and $La_2(SO_4)_3$, but has no effect on the decomposition of $CoSO_4$. (36 refs.)

39118 (NP-tr—1966) **Investigation into the fusion processes in fuel ashes. Part II.** Bunte, K.; Baum, K. Translated from *Gas-Wasserfach;* **71**: 125-130(1928). 14p. U 02/MF A01.

Major progress in the assessment of the melting process of ashes showed that fusibility is due mainly to the degree of oxidation (the influence of reducing and oxidizing gas atmospheres), and it also showed that account must be taken of the fact that it is not a melting process that is involved similar to that in chemically uniform substances which show a melting point but that a distinction must be drawn between a softening point, a melting point, and a flow point, i.e., a temperature at which a change of shape first occurs in the form of sintering of the surface, a temperature at which plasticity becomes such that for example the cone bends over (the collapsing point of the cone), and finally a temperature at which the viscosity assumes a magnitude such that the remainder of the shape becomes obliterated, i.e., that flow occurs. By distinguishing between these different stages of melting nothing has been achieved so far except that a subjective element has been introduced into observation. In accordance with information provided by the US Bureau of Mines, even skilled observers only succeed in reaching agreement to within 50°C between different observers. The desire to obtain an objective method for determining the melting processes in ashes has therefore been voiced repeatedly. The most important conditions for the determination of reproduceable values were found to be the follow-

ing: objective observation; a suitable atmosphere; specification of the shape and size of the specimen; specification of the fineness of the ash; and specification of the temperature rise or the demonstration that when a given method is used one or the other of the last three of the above factors has no effect.

39119 Low-temperature purification of coke gas with polar organic solvents. Kosyakov, N.E.; Barabash, I.I.; Bereznitskii, V.S.; Ivanova, A.S.; Chobot'ko, L.L. *Sov. Chem. Ind. (Engl. Transl.);* **8**: No. 9, 721(Sep 1976).

Translated from Khim. Prom.; 8: No. 9, 685-686(1976).

The article examines the possibility of the complex removal of acid, sulfur-containing acetylene, diene and other impurities from coke gas using cooled methanol and solutions of monoethanolamine (MEA) in methanol. The economic efficiency of this method is compared with existing methods. Data are presented which characterize the solubility of carbon dioxide in solutions of MEA in methanol at temperatures from 0°C to -40°C and at pressures to 600 mm Hg.

39120 Magnesite method for extracting SO_2 from waste gases. Budanov, V.I.; Rybakov, L.A.; Gladkii, A.V. *Sov. Chem. Ind. (Engl. Transl.);* **8**: No. 9, 712-715(Sep 1976).

Translated from Khim. Prom.; 8: No. 9, 678-681(1976).

The kinetics of sulfur dioxide absorption from power plant flue gases from Donets coal are examined on a pilot plant unit of 30,000 m^3 per hour in yield. Gas purification was done by the magnesite method in a spray type absorber (STA). Empirical equations are presented for calculating the hydraulic resistance of the absorber and the mass transfer in the system over a wide range of operating parameters. Optimal ranges for the process are determined.

39121 Disposal of organic impurities from coking plant waste waters. Grudzien, J.M. (Instytut Chemicznej Przerobki Wegla, Zabrze, Poland). *Koks, Smola, Gaz;* **21**: No. 12, 367-372(Dec 1976). (In Polish).

A motivation is given of the need for removing organic compounds from coking plant waste waters after having destroyed their inherent phenols by the biochemical method. The use of sorption on active carbon or on similar sorbents is proposed for this purpose. Basic problems regarding sorption are discussed and results of the preliminary investigations on removing organic compounds from coking plant waste waters are given.

39122 Attempts aimed at applying the biooxidation process to neutralize the excess activated sludge from an industrial installation for coking plant waste water purification. Olczak, Z.; Wolany, B. *Koks, Smola, Gaz;* **22**: No. 1, 13-17(Jan 1977). (In Polish).

Results of tests are presented of aerobic excessive sludge digestion deriving from an industrial installation for purifying coking plant waste waters. Tests carried out at an increased aeration have shown the unserviceablenss of this method. The activated sludge was subject to mineralization merely to a small extent while simultaneously a worsening of its hydrating capacity was taking place.

39123 Electrobiochemical neutralization of acid mine water. Sisler, F.D.; Senftle, F.E.; Skinner, J. (Geological Survey, Reston, VA). *J. Water Pollut. Control Fed.;* **49**: No. 3, 369-374(Mar 1977).

Anaerobic activity by Desulfovibrio and associated bacteria in the bottom of an acid-mine lake will in time reduce the acidity if an energy source in the form of organic matter is available. The time required for neutralization may require 50 to 70 days depending on the pH and SO_4^{2-} concentration. The reaction rate can be accelerated by bleeding off the charge on the S^{2-} ion produced during the anaerobic reduction of SO_4^{2-} through an external circuit. This was accomplished in a laboratory test cell by short circuiting an iron electrode in the anaerobic mud at the bottom of the cell with a carbon electrode suspended in the water. Under the short-circuit conditions, neutralization of simulated acid lake water was accomplished in about 12 days. When larger surface-area electrodes were used and a more favorable ratio of water to anaerobic mud was used, this time was reduced to about 5 days. The practical application to static holding ponds and to water flowing through several holding tanks or ponds at a mine site are projected from laboratory results.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 39059, 39060, 39078, 39451, 39659, 40124, 40218

39124 (CONF-7606131—1) **Research and development relating to lignite use in power production.** Sondreal, E.A.; Gronhovd, G.H.; Kube, W.R. (Energy Research and Development Administration, Grand Forks, N.Dak. (USA). Grand Forks Energy Research Center). 1976. 32p. Dep. NTIS $4.00.

From symposium of Gulf Coast legnile, geology, utilization, and environmental aspects; Austin, Texas, United States of America (USA) (2 Jun 1976).

The present emphasis on coal utilization in the United States together with the requirements for reduction of sulfur dioxide emissions has dramatically increased utilization of lignite and subbituminous coals to over 80 million tons annually, mostly for electrical power generation. Boiler and fuel specifications are summarized for three new facilities from 400 to 550 MW designed to use high fouling lignites from Texas and North Dakota. Ash fouling of fire-side boiler tubes is the most serious operating problem. Designs are conservative with low furnace heat release rates, relatively wide tube spacing, and soot blowers. Research in ash fouling is described and the role of sodium as an indicator of fouling discussed. Particulate emissions from boilers fired with low-rank coals are being controlled using electrostatic precipitators and wet scrubbers. Design data are presented and research activities reviewed. High moisture and high sodium contents result in satisfactory performance for ESPs operating on North Dakota lignite. Although lignites are considered low in sulfur, most lignite-fired boilers will require some SO_2 removal to meet emission standards. Research work on use of the natural alkali in lignite fly ash in wet scrubbers is discussed. Included are data on operating and planned ash-alkali scrubbers. Emission standards are reviewed.

39125 Simulation of the effects of acid mine drainage in impoundments. Chadderton, R.A. (Pennsylvania State Univ., University Park). pp 208-212 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

Water resource systems have been subjected to acid pollution since the first coal mines began operation. The mining process exposes coal-associated iron sulfides to air and water, thus causing oxidation. The effects of acid mine drainage on receiving waters include increased acidity and total solids. The development of a computer simulation model of the behavior of acidity and pH parameters throughout a surface impoundment is described. The steady-state model is based upon principles of water chemistry. To develop the model, the impoundment is divided into a number of complete-mix elements. Two conservative quantities, alkalinity and total inorganic carbon, are routed through the model to determine the concentration of these two parameters in each model element. An iterative procedure is used to account for the loss of carbon dioxide due to gas transfer. After the values of alkalinity and total inorganic carbon have been found, a series of independent quartic equations is written for the hydrogen ion concentrations in the lake elements. The Newton-Raphson method is used to solve each quartic equation. Then the pH is calculated for each element. Results of the modelling process are alkalinity and acidity concentrations and pH for each lake element. The model was verified by comparison of simulation results with field data collected from four Pennsylvania lakes from September 1974 through August 1975. An important application of the model will be the investigation of changes in water quality which result from restoration activities or from new mining releases.

39126 Simulation model for environmental pollution control from fossil fuel power plants. Rao, R.K. (Westinghouse Environmental Systems Dept., Pittsburgh); Roffman, A.; Taylor, D.R.; Bauder, R.J. pp 414-419 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

Computer simulation is expanding rapidly into many disciplines because of its usefulness in solving complex problems through mathematical models. In recent years its application in solving earth's environmental problems is assuming increasing importance. Following the passage of the Clean Air Act in 1970, it has become mandatory on power plant industries in the United States to curtail emissions from their sources in order to meet and maintain ambient air quality standards prescribed by the federal and state governments. This paper presents a simulation model for a fossil-fuel power plant which includes "air quality dispersion predictive scheme and an effective control scheme" which forewarns the plant operators of possible violations of ambient air quality standards and suggests several options on the basis of economy of cost.

39127 Numerical model for regional transport of sulfur pollutants in the atmosphere. Rao, K.S.; Ingersoll, C.S.; Egan, B.A. (Environmental Research and Tech., Concord, MA). pp 420-425 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

A numerical air pollution transport model due to Egan and Mahoney has been adapted to simulate the regional transport of sulfur dioxide and particulate sulfates. This quasi-Lagrangian, three-dimensional grid model incorporates a detailed SO_2 emission inventory of major anthropogenic sources in the eastern U. S. region, and accounts for the horizontal advective transport as well as turbulent diffusion of the species. The chemical transformation of SO_2 to SO_4 and the deposition of the species at the earth's surface are assumed to be linear processes at specified constant rates. The model uses detailed meteorological inputs such as the observed wind and mixing depth data during an episode, grid topography and a diurnally-varying eddy diffusivity profile. The numerical method conserves the zeroth, first and second moments of the mass distribution of the SO_2 and SO_4 species in the grid, thus eliminating the pseudo-diffusive errors associated with the conventional finite-difference approximations. By integrating the species conservation equations with respect to time and appropriate time-averaging, the three-dimensional numerical grid model can simultaneously predict the daily average concentrations of SO_2 and SO_4 at all receptor locations in the grid region during the episode. The averaging time period can be easily adjusted to suit the modeler's specific requirements. For the turbulent diffusion calculations, the model has three vertical air layers of uniform depth over the grid region. Because of the spatial resolution of the three-dimensional grid, this model is particularly suited to investigate the effects of tall stacks in reducing the ambient concentration levels of SO_2 and SO_4. The principles and formulations of the numerical regional transport model are discussed as well as its simplifying assumptions. The calculated species concentrations are compared with the corresponding observed values.

39128 Effect of coal surface mining on water quality of mountain drainage basin streams. Minear, R.A.; Tschantz, B.A. *J. Water Pollut. Control Fed.;* **48**: No. 11, 2549-2569(Nov 1976).

Six small watershed,s ranging from 1.7 to 11 sq km (0.7 to 4.3 sq mi) within the New River Basin of the Cumberland Mountains of Northern Tennessee have been monitored weekly and simultaneously for water quality between January and December 1975. Three watersheds were undisturbed by mining activity and served to establish benchmark data. The other three watersheds represented varying stages of coal mining activity, ranging from initiation of surface mining in one watershed to essentially complete stripping three years ago and current deep mining activity in another. Distinct differences are observed for the variables pH, alkalinity, sulfate, calcium, magnesium, iron, manganese, total solids, and suspended solids among the disturbed watersheds. In contrast to the undisturbed watershed stream constituent concentrations were quite uniform from stream to stream and from sample to sample.

39129 Predicting the quality of mine water discharges. Henton, M.P. *Effluent Water Treat. J.;* **16**: No. 11, 568-572(Nov 1976).

It is hoped that water quality predictions can be made from a compilation of all the data relevant to the Fife coalfields as a whole and then to supplement this with the information specifically applicable to the site under consideration. The information would be of value in the water quality management program and to the operator in deciding on the amount of treatment required prior to discharge. Several trends emerge from figures taken from last year's sampling program which are useful in determining the general water quality pattern in Fife coalfields. (CAJ)

39130 Fly ash and furnace gas characteristics. White, H.J. *J. Air Pollut. Control Assoc.;* **27**: No. 2, 114-137(Feb 1977).

The particle and gas properties that profoundly affect design and performance of fly ash precipitators are discussed and evaluated in this section. Relation of the coal burned to these properties and to the precipitator gas cleaning is broadly examined. The need for a high order of technology consistently applied to cope successfully with the wide and often uncertain variations in coal and ash properties encountered in precipitation practices is emphasized.

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 39133, 39140, 39153, 39376

MINING

REFER ALSO TO CITATION(S) 39129, 39165, 39375, 39376, 40218

39131 (FE—1231-6) Design optimization in underground coal systems. Interim report, July—September 1976. Lucas, J.R. (ed.). (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Div. of Minerals Engineering). Dec 1976. Contract EX-76-C-01-1231. 49p. P 03/MF A01.

Additional coal samples were gathered from the York, Sunnyside, and Allen seams. Results of simple compression tests performed on limestone are summarized for 111 cubical and cylindrical specimens. The data suggest that within the size range examined very little distinction in sample strength can be made on the basis of shape. There was scatter in the raw data, but it is evident that the shape and size effects are more pronounced for weak rather than for strong materials. An initial cube-cylinder ratio vs. area plot for coal shows that when areas are small, cubes are much stronger than cylindrical specimens. As specimens become larger, the strengths become equal. This is the expected trend but the program is being checked since the magnitudes seem large. The longwall simulator is being revised to accept borehole input. A new input routine has been designed that is flexible and user oriented. An interactive system (Dataload System) has been designed and incorporated into the testing procedures in the rock mechanics lab. The interactive system serves a dual purpose. It takes data obtained from tests by the operator in a real-time environment, sets the data up, and starts the analysis using the TDRR program for the structural characteristics of the coal section for the longwall simulator. Several methods of analysis have been employed to study theoretically the effects of a roof truss in a mine roof. Abbreviated analyses are given. The action of the roof truss may be likened to the action of prestressed rebar in concrete, realizing, that the roof truss is not continuously bonded as is the rebar. With this method of analysis, the roof is assumed to be incapable of supporting tension. Tension must be carried by the truss. This is a conservative assumption, since many mine roofs do not fail even though they have no external tension carrying support.

39132 (PB—259203) Field evaluation of fluorescent luminaires in underground coal mines. Final report. Ketler, A.; Pellman, R. (Ocean Energy, Inc., Blairsville, Pa. (USA)). 27 Feb 1976. Contract H0242050. 52p. Q 04/MF A01.

The Bureau of Mines recognized the need for additional experience in the illumination of the working places of coal mines. This article reports the performance of several fluorescent illumination systems which were installed on several different types of mining machines. (GRA)

39133 (SR—111) Analysis of underground extraction techniques for thick coal seams. Bise, C.J.; Ramani, R.V.; Stefanko, R. (Pennsylvania State Univ., University Park (USA). Coal Research Section). 12 Oct 1976. 231p. Pennsylvania State Univ., University Park.

The problems, technical and nontechnical, which are associated with the mining of thick coal seams are analyzed in this thesis. Mining methods currently practiced abroad are reviewed. A discussion of North American thick-seam mining, based on information gathered from mine-site visits and published literature, is also included. On the basis of an inventory of geologic and mining conditions in the West, four methods are recommended for potential application. An economic evaluation of the proposed methods, on a panel basis, has been conducted. A comparative analysis of the proposed methods with typical conventional and continuous sections is provided. The thesis has arrived at a number of conclusions. Although there are several thick-seam methods practiced abroad, these methods cannot be adapted, for the most part, without variations for U.S. conditions. This is due, mainly to the different economic and political climate of the U.S. However, thick-seam methods can be designed to be economically competitive with methods employed in seams of average thickness. Further, the recovery rates are also acceptable. New equipment, such as shields, should find increased acceptance whereas standard U.S. equipment, such as shuttle cars, will have limited applications.

39134 (NP-tr—1968) Dimensioning of coal pillars ahead of maingates using long-reach measuring bolts. Eichholz, K. Translated from *Glueckauf;* **111**: No. 20, 974-979(15 Oct 1975). 17p. U 02/MF A01.

As observations show, the measuring bolt method gives rapid and reliable results on the course of rock movement in maingates during the approach of production. The sensitivity of the method makes it possible to detect effects on the mineworking at an early stage, whilst a simple approximation method provides reasonably reliable final convergence and loosening-up movement from a point in time at which the face is to be stopped. The method is therefore suitable for establishing pillar widths in maingates. Generally speaking, these widths can be smaller than adopted hitherto, the minimum value being 15 m. The reduction in production losses obtained by reducing the pillar width is of considerable economic benefit and presents no risk from the point of view of roadway standing capability.

39135 In-seam mining. Hetherington, G.A. (Natl Coal Board). *Min. Eng. (London);* **135**: No. 185, 691-698(1976).

This is an account of mining situation which arose at Ashington Colliery in Northumberland, whereby conventional advance longwall mechanized mining was replaced by in-seam retreat methods. Comparative results achieved by the two systems in adjacent working areas show substantial improvement in OMS (Output per Manshift) and bulk tonnage achieved by the retreat method. Critical engineering problems of roadhead support and mineral handling are discussed and the innovations introduced to overcome them are

described in some detail. Special emphasis is made of the need for the related improvement in rates of development drivage required to keep pace with retreat mining, and it is suggested that a lack of incentive reward is a major restriction in this respect.

39136 Osnovy postroeniya i rascheta edinoi telemekhanicheskoi sistemy ugol'noi shakhty. (Principles of the construction and calculation of a single telemechanical system for coal mines). Ivanchenko, G.E. Moscow; Nedra (1976). 175p.

Bases and selection of rational principles of construction of a united telemechanical system for coal mines, which uses the method of intensity for transfer of information signals, are described. Examples are given, which permit selection calculation and adjustment of such a system.

39137 Coal. II. Current advances in coal chemistry and mining techniques. New York; MSS Information Corporation (1976). 152p.

Four articles from this book have been entered individually into EDB and ERA. The article, "Degasification of Virgin Pittsburgh Coalbed Through a Large Borehole," by H.H. Fields, Stephen Krickovic, Albert Sainato and M.G. Zabetakis has been entered previously from another source as item 75: 002117. The articles involve analytical methods for mine dusts, spontaneous combustion, degasification, diffusion of methane through coal, and measurements of carbon 12/carbon 13 ratio of methane and ethane gases desorbed from coal or released by pyrolysis. (LTN)

39138 Spontaneous combustion: a coal mining hazard. Feng, K.K.; Chakravorty, R.N.; Cochrane, T.S. pp 66-91 of In Coal. II. Current advances in coal chemistry and mining techniques. New York; MSS Information Corporation (1976).

There is growing evidence that modern methods of mining coal increase the risk of spontaneous combustion. Seemingly unimportant at this time, this hazard could prove to be a barrier to growth and development of the coal industry in some areas of Canada. The paper presents bedrock knowledge on spontaneous combustion gathered by scanning and evaluating current technical and research literature. Special efforts have been made to identify significant coal and environmental factors and to establish criteria for susceptibility. In addition to the state-of-the-art knowledge, preliminary results fron on-going studies are discussed.

39139 Kompleksnaya mekhanizatsiya i avtomatizatsiya proizvodstvennykh protsessov na ugol'nykh shakhtakh. (Mechanization and automation of industrial processes in coal mines). Kuzyukov, F.F.; Michkov, V.A.; Podyukov, V.A.; Kornilkov, V.N. Moscow; Nedra (1976). 287p.

The status, problems, and basic trends in the development of integrated mechanization for cleaning operations in coal mines are discussed. The principles followed in opening up and preparing a mine field for a mechanized coal mine are examined. The mechanized equipment for cleaning the faces and for extraction during development of sloping and inclined strata, where heaping of the coal is required, are described. The equipment used in development of inclined and steep strata, where heaping is not required, is also discussed.

39140 Design of support systems for future longwall faces--an overview. Ghose, A.K. (Indian Sch of Mines, Dhanbad). *J. Mines, Met. Fuels;* **24**: No. 5, 141-147, 156(May 1976).

Under the 10-year Perspective Plan of Coal India Ltd., longwall mining with caving is expected to account for 23% of underground coal output by 1985-86. Since the design of an effective support system is the key to successful longwall mining, the important factors involved in the design of support systems for caving longwalls within the Indian context, where experience has thus far been limited to individual props and bars are highlighted. A brief survey of global developments in the design of supports for thick seams is also given in order to identify the trends in support systems for longwall faces during the next decade. 18 refs.

39141 Choice of powered support. Mitra, D. (Sofremines Ltd., Calcutta, India). *J. Mines, Met. Fuels;* **24**: No. 5, 148-150(May 1976).

A review is presented the current knowledge regarding the selection of powered supports for longwall mining of coal, once the necessary analyses had been made and the decision on capital commitment reached. Operational characteristics of powered supports are discussed, as well as the problems affecting the efficiency of these supports. Adaptability of powered supports to coal winning machines is also considered.

39142 Some recent developments in powered roof supports. Allen, A.D. (Gullick Dobson Ltd., Wigan, Lancashire, Eng.). *J. Mines, Met. Fuels;* **24**: No. 5, 157-168(May 1976).

Some recent developments in powered roof supports used in coal mines are reviewed. After a summary of support developments in Britain, a discussion is presented of some control system developments, and support developments for the export market followed by some variations for use at roadends. The product developments of Gullick Dobson Ltd of the United Kingdom, are highlighted.

39143 Roof bolting in India mines: A survey of recent developments. Goenka, J.P. (Nanda Miller Co., Calcutta, India). *J. Mines, Met. Fuels;* **24**: No. 5, 169-173(May 1976).

Rising Indian coal production in recent years has increased the need for supports, especially in pillar-extraction areas, longwall workings and in disturbed areas. At present, supports in India's coal mines are chiefly made of timber. A survey is presented of recent developments in roof bolting, as an alternative method of support, which could help ease the demand for timber. Different types of roof bolts are discussed along with the anchorage of bolts, with special emphasis on resin bolting. 3 refs.

39144 (PB—255300) Three coal mine ventilation studies using sulfur hexafluoride tracer gas. Report of investigations. Vinson, R.P.; Kissell, F.N. (Bureau of Mines, Pittsburgh, Pa. (USA). Pittsburgh Mining and Safety Research Center). Jun 1976. 25p. (BM-RI—8142). NTIS $3.50.

This report describes three coal mine ventilation studies by the Bureau of Mines in which SF6 was used as a tracer gas. One of these studies was conducted to determine air movement and leakage in a sealed area. Another was run to determine the ventilation efficiency of a bleeder system. Finally, a study was made of air leakage across permanent stoppings of parallel intake airways. These studies proved sulfur hexafluoride to be a useful addition to the equipment commonly used in coal mine ventilation analysis. (GRA)

39145 Opencut for mine filling material. *Aust. Min.;* **68**: No. 8, 26-27(Aug 1976).

The problem of filling voids left after ore removal underground at Mount Isa has led to the development of an opencut currently producing 45,000 tonnes a week of crushed and graded rock, building up to 63,000 tonnes per week. The rock is carried from the crusher by a three km-long conveyor system, and passed down a choke-filled shaft to the mine area to be filled where it is mixed with deslimed concentrator tailings and cement. It is placed in empty stopes, where it soon forms into a hard rock-like structure. This allows the pillars of ore in between the filled stopes to be safely mined out. The ratio of crushed rock to cemented tailings is about 2:1.

39146 Method and apparatus for measuring incombustible content of coal mine dust using gamma-ray backscatter. Armstrong, F.E. (to Energy Research and Development Administration). US Patent 3,983,392. 28 Sep 1976. Filed date 14 Feb 1975. 10p.

PAT-APPL-550,099.

A method and apparatus for measuring incombustible content of particulate material, particularly coal mine dust, include placing a sample of the particulate material in a container to define a pair of angularly oriented surfaces of the sample, directing an incident gamma-ray beam from a radiation source at one surface of the sample and detecting gamma-ray backscatter from the other surface of the sample with a radiation detector having an output operating a display to indicate incombustible content of the sample. The positioning of the source and detector along different surfaces of the sample permits the depth of the scattering volume defined by intersection of the incident beam and a detection cone from the detector to be selected such that variations in scattered radiation produced by variations in density of the sample are compensated by variations in the attenuation of the incident beam and the gamma-ray backscatter. 17 claims 5 figures.

39147 Control of friable wastes and roofs. Gillard, D.A.; Kibble, J.D. (NCB Min. Res. and DEv. Establ., Bretby, Eng). *Min. Eng. (London);* **136**: No. 186, 39-45(Oct 1976).

The design of a powered support involves many factors intimately related to the conditions under which it is used. Often these are such that debris from the waste floods in the working areas reduces safety and impedes production. The paper describes continuing work at the U.K.'s MRDE (Mining Research and Development Establishment) on this problem, leading to the development of a flushing guard which has proved a successful solution. Problems remaining for future work, such as the exclusion of loose material from the roof rather than from the waste are also discussed. 5 refs.

39148 Experience with anhydrite packing (ANPAC) at Easington Colliery. Smith, I. *Min. Eng. (London);* **136**: No. 186, 47-52(Oct 1976).

As a further step in a continuing effort to find a solution to face roadway deterioration, it was decided to institute a trial using crushed anhydrite as a packing medium at the gate end of an advancing face. The equipment required and the general operation of the system are detailed together with costs. Results are given from an investigation of the trial being carried out by the Mining Department, University of Newcastle upon Tyne. The trial has been continued over a period of one year and 600 yd of roadway have been packed. The roadway has remained in good condition, maintaining a good profile and no back ripping has been necessary.

39149 Communications in mining. Hall, J.R. (Natl. Coal Board, Doncaster, Eng.). *Min. Eng. (London);* **136**: No. 186, 53-61(Oct 1976).

The subject of communications in its broadest sense in considered. The development of different forms of communication to date is reviewed and trends in development to changes of circumstances, both within the industry and outside it are presented. The mutual influence between the state of the art of communications and mining methods is underlined, and the paper concludes with a discussion of present technology and its application to mining. 5 refs.

39150 Old No. 26 and new Lingan properties produce 2.5 million tpy of coal. *Can. Min. J.;* **97**: No. 11, 11, 13, 15(Nov 1976).

Mechanized longwalls have been operating in the Cape Breton collieries since the mid-sixties, and there are now three each in the renovated No. 26 Colliery and the recently commissioned Lingan Mine. The two coal mines where longwalls are operating together accounted for 1.5 million tons of coal in 1975, and this will increase to roughly 2.5 million tons in 1976. The production goal at No. 26 of 4,150 tpd is now being achieved. At Lingan the goal of 7,600 tpd should be met by the end of the year. Devco's two longwall mines operate in the Glace Bay-New Waterford area, three or four miles out to sea under the Indian Bay.

39151 Mechanized longwall mining technique has made Devco boom possible. *Can. Min. J.;* **97**: No. 11, 16-17, 20(Nov 1976).

Devco employs the 'advancing' longwall technique. The machine starts out from the deeps or roadways, and 'advances' through the seam, cutting its own levels as it progresses. The advancing system has allowed Devco to produce coal from the moment its equipment is delivered. The retreating system is less costly in the long run, and will be used on future western faces in the Lingan Mine. At present the equipment and the mining method at the No. 26 and Lingan longwalls is essentially identical. The length of the face averages 600 ft.

39152 Devco's room and pillar Prince Mine produces thermal coal for utilities. *Can. Min. J.;* **97**: No. 11, 28-29(Nov 1976).

The Prince is Devco's newest mine, a relatively low cost ($12 million) room and pillar operation that provides thermal grade coal for the Nova Scotia Power Corp's Trenton generating station. Output from the Prince will replace that from the 100 year old Princess Colliery, which was North America's oldest producing mine when it closed down earlier this year. Mining at the Prince is in the 7.5 ft high Hub or Stubbard Seam which dips seaward at a seven per cent slope from the outcrop on the surface.

39153 Fording's dual operations are unique in Canada. Fish, R. *Can. Min. J.;* **97**: No. 11, 42-49(Nov 1976).

Fording is owned 60% by Canadian Pacific Investments and 40% by Cominco, which manages and staffs the operation. Fording Coal's two main pit operations, the Clode and the Greenhills, lie on the east and west sides, respectively, of the Fording River with the wash plant between them. The coal seams in both pits are of the Kootenay Formation and each set of seams occurs in a broad north-trending sycline separated from one another by the Erickson fault, a regional feature which coincides with the Fording River at this point and dips to the west. In both pits ten seams of mineable thickness occur, but on opposite limbs of the syclines.

39154 Hydraulic mining at Kaiser Resources unlocks new coal seams. Overend, M. *Can. Min. J.;* **97**: No. 11, 53, 55-56(Nov 1976).

Within five years, Kaiser Resources Limited, at Sparwood, B.C., has turned a $32 million accumulated loss into a $71 million profit in 1975. The Sparwood operation is a combination of surface mining, conventional underground mining, and a new development in underground technology, hydraulic mining. Production is about 6.5 million tons of metallurgical coal a year, most of which is sold under long term contracts to Japan. The balance goes to Eastern Canada, Korea, Mexico and Italy.

39155 Wide web working in the ten feet seam at Holditch Colliery. Hardman, D. *Min. Eng. (London);* **136**: No. 187, 97-112(Nov 1976).

A detailed description is presented of the reasons for, and the operation of, wide web working on No. 3 Ten Feet face at Holditch Colliery in the North Staffordshire coalfield. The equipment, layout, ventilation and operating results are discussed and finally conclusions are drawn, one of which is that the system, using existing and available equipment, has proved to be highly successful. It would appear to be a natural and logical progression in the quest for productivity and safety. 2 refs.

39156 Guidelines for the selection and use of in-mine dust collectors. Divers, E.F. (Bureau of Mines, Pittsburgh). *Coal Age;* **81**: No. 11, 105-106, 108(Nov 1976).

Scrubbers are generally accepted as one approach for controlling dust in coal mines. Frequently claimed and usually justifiable advantages of scrubbers are reduced respirable dust levels, reduced rockdusting requirements, improved face visibility, and low impact on production compared with some other dust control techniques. Scrubbers also appear to be an especially powerful dust control technique for sections using blowing ventilation where miners are exposed to dust-laden air returning from face operations. However, anyone considering the use of a scrubber for coal mine dust control usually faces a bewildering choice of scrubber types and dust collector efficiency claims. Several years ago, the Bureau of Mines initiated a research program to evaluate the effectiveness of prospective commercial scrubbers and, if required, develop new scrubbers. The program concentrated on small, uncomplicated scrubbers with high dust collection efficiency. The venturi type of scrubber is a good example of one of the better scrubbers developed under the program. The venturi also possesses most of the characteristics desirable for a good underground scrubber.

39157 Geotechnical analysis of rock structure and fabric in the C.S.A. Mine, Cobar, New South Wales. Barton, C.M. East Melbourne; Commonwealth Scientific and Industrial Research Organization (1977). 30p.

Rock structure and fabric at the C.S.A. Mine, Cobar, N.S.W., are defined, and appropriate parameters are used to provide some guidelines for material behavior and support requirements. An analysis of some 24,000 feature traces indicates that joint and minor fault intensity decreases away from the vicinity of the stopes and is lower in the inter-stope areas above 370 m. The mean normal-to-plane line spacing and length of over 1000 predominant joints, considered in terms of a log-normal model, are revealed as 13 cm and 38 cm, respectively. The joints are approximately equi-dimensional in outline with inferred mean areas of 800 sq cm and a mean relative continuity, along the line of the features, of nearly 50 percent. Acceptance of a joint peak shear strength, which is sensitive both to roughness and rock wall character, provides evidence to support the view that shear is unlikely to occur along joints, within the rock mass away from the vicinity of the underground openings. Fabric data are incorporated in an empirical design model to reveal a medium to high strength rock mass. Systems of rock quality designation, rock structure rating, rock mass ratio, and support index are invoked to provide guidelines for support of the underground openings. Although the systems are highly empirical and require further development, the results are often close to actual support practice. Initial results of a finite element analysis of a type cross-section indicate that failure of intact rock is unlikely and that both stress release and shear movements are feasible at localized points along the footwalls of the ore bodies. Indicated displacements on the discontinuities within the crown pillar areas are well within the elastic limits of the material.

39158 U.S. introduces changes in contour mining methods. *Coal, Gold Base Miner. South. Afr.;* **25**: No. 2, 71, 73, 79(Feb 1977).

In 1973, the coal production in the United States amounted to 590 Mt. Of this amount, about 110 Mt were produced by contour mining in the Appalachian field. This contour mined coal is predicted to remain in demand in the future years, but with more stringent and rigidly enforced reclamation laws.

39159 Method of securing objects in passages and arrangement obtained thereby, particularly hose lines sealingly secured in the passages of coal mines for dust suppression. Meyer, F.; Becker, H.; Goretz, H. (to Bergwerksverband GmbH). US Patent 4,008,576. 22 Feb 1977. Priority date 8 Sep 1973, German, Federal Republic of (F.R. Germany). 8p.

An object extends into a passage and defines a clearance space with the inner wall of the passage. A hardenable, foamable synthetic resin in flowable state is admitted into the clearance space. Upon hardening and foaming of the synthetic resin, the object is sealingly secured in the passage by the synthetic resin. In a preferred application, the passage is one provided in a coal mine and the object is a hose line for the purpose of suppressing dust. The synthetic resin is advantageously polyurethane including a polyhydroxyl component which contains a polyetherglycol having a hydroxyl number of 300 to 350 and a polyetherglycol having a hydroxyl number of 450 to 500. The polyetherglycol components, respectively, constitute 80 to 90 parts and 10 to 20 parts of the polyhydroxyl component. The polyhydroxyl component preferably includes a filler in an amount such that the weight of the latter at least equals that of the polyhydroxyl component. 26 claims, 1 figure.

39160 Powered roof supports today- and tomorrow. Shiels, design criteria, and control devices. Shepherd, R. *Mine Quarry;* **6**: No. 3, 17-18, 20, 23, 26(Mar 1977).

Powered roof supports available for longwall coal mining are described. Some design features (setting load, yield load, canopies, types, safety, control, remote control) are considered, mostly with respect to U.K. manufacturers and equipment used in the U.K. (LTN)

39161 Peabody mine's Serpentix boosts mining output. Chironis, N.P. *Coal Age;* **82**: No. 4, 58-64(Apr 1977).

The successful application of a monorail continuous haulage system at the No. 10 mine of Peabody Coal Co. near Springfield, Ill.

is encouraging management to convert more of the continuous miner sections in Peabody mines over to the new haulage technique. Originally from Germany, the Serpentix system, as it is called, has been considerably modified and improved upon by Peabody engineers. It is now a snake-like system hung from a monorail track that essentially supports a powered flexible conveyor belt capable of operating around corners. During actual operations at No. 10, the Serpentix has been almost able to double the output of a continuous miner team. Modifications are being completed on the Serpentix that will improve its operation and increase continuous miner output still more. Furthermore, Peabody's Technical Support group is working out details on a mining system that would team the Serpentix with a shortwall system.

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 39047, 39055, 39161, 39168, 39690, 39749

39162 (CONF-761019—, pp 121-123) **Coal—oil mixture additives and process.** Metzger, G.W. Feb 1977.

From Coal-oil slurry combustion technology exchange workshop; Washington, District of Columbia, United States of America (USA) (29 Oct 1976).

In Proceedings of the coal—oil mixture combustion technology exchange workshop.

The Carbonoyl Company came to the conclusion early in its research that a most important key to successful coal-oil mixtures (COM) technology would be to make COM economically acceptable to industry. Therefore, our efforts were directed toward useable COM's at a cost that would not penalize industry to change over from burning oil or gas. With the Carbonoyl additives, we now design each COM to have adequate stability for handling and storing, and we recommend the use of agitation to maintain a homogeneous mixture. In COM technology, the use of agitation is a well developed science, and, in our opinion, it is preferable to using expensive chemicals to try to accomplish homogeneity by attempting to produce 100 percent stability. All industry wants and needs is a reliable fuel at the lowest-possible cost. We are also advocates of proper coal preparation as another important key to producing good useable mixtures. We prefer a grind with no tramp oversize (plus 48 mesh) and about 80 percent passing 200 mesh. It is our present opinion that the most efficient, safest, and least costly method will prove to be grinding the coal in ball mills with the oil. Experimental work will be required to develop the basic data needed for mill sizing and design. This method will also automatically take care of most of the mixing cycle, and it is the best way to design for continuous production.

39163 (FE—1792-20) **Coal feeder development program. Quarterly technical progress report, July—September 1976.** (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif. (USA)). 30 Sep 1976. Contract EX-76-C-01-2286. 80p. Dep. NTIS $5.00.

This report covers the work carried out during the third quarter of the Phase II effort on the Coal Feeder Development Program. During the reporting period, the Coal Feeder Test Loop was installed and brought to full operational status. Test hardware for the Kinetic Extruder and Fluid Dynamic Lock concepts was fabricated, and testing with the Kinetic Extruder has begun. Analysis of data obtained with the bench-scale Ejector was completed and a larger-scale version is being designed. During the next quarter, extensive testing will be accomplished with the Kinetic Extruder and the Fluid Dynamic Lock.

39164 Wash plant converts mine product to highly desired metallurgical coal. *Can. Min. J.;* **97**: No. 11, 23-25(Nov 1976).

Sulfur impurities in the Cape Breton coal make it unsuitable for steel producers without treatment. Therefore, in May, 1974 the company commenced construction of a coal preparation plant located at the junction of the rail lines from the No. 26 and Lingan mines. The first load of coal went through the Devco wash plant on Oct 4, 1976. Coal from the two sources is being processed separately, and sulfur reduced to acceptable quantities.

39165 Some developments and disciplines in underground rail transport. Lunnon, C. (Natl. Coal Board, Doncaster, Eng.). *Min. Eng. (London);* **136**: No. 187, 113-125(Nov 1976).

The merits of rail traction underground are discussed together with the limitations of existing prime-movers. Two new prime-movers are examined, and the promising liquid-nitrogen engine is described. Various means of dealing with gradients to a steep for ordinary locomotive haulage are considered, and certain aspects of rope haulage which merit special developments are examined. The use of prefabricated fixed-length panels of conventional track is recommended for gate roads. Reasoned arguments are developed for the adoption of 760 mm track gage as a national standard for new collieries, and similarly recommendations are given for a standard coupling. An important improvement to supplies cars is described. Operational recommendations include a well-disciplined use of loops and pass-byes, and a much wider use of 'stop' lines at fouling points on converging roads. 9 refs.

COMBUSTION

REFER ALSO TO CITATION(S) 39080, 39084, 39124, 39138, 39461, 39693, 39998

39166 (CONF-731109—3) **NO/sub x/ control by flue gas recirculation in pulverized-fuel combustion.** Henry, J.M.; McCann, C.R.; Demeter, J.J.; Bienstock, D. (Bureau of Mines, Pittsburgh, Pa. (USA). Energy Research Center). 1973. 11p. Bureau of Mines, Pittsburgh, PA.

From 66. annual meeting of the American Institute of Chemical Engineers; Philadelphia, Pennsylvania, USA (11 Nov 1973).

Flue-gas recirculation in a pulverized-fuel furnace is shown to be effective in reducing NO/sub x/ emissions. The furnace burns 500 lb of coal per hour and simulates the operation of larger industrial and utility boilers. Flue gas was cooled to 350°F and recirculated into the flame zone in the range of 7 to 33 percent of the input air supply. NO/sub x/ emissions with no flue gas recirculation were 1.44 g/10^6 cal (calculated as NO_2); with flue gas recirculation, reductions of 6 to 44 percent in NO/sub x/ emissions were observed. A mathematical model of the NO/sub x/ chemistry of the furnace was examined in parallel with the experiments to determine the sensitivity of NO/sub x/ emissions to flue gas recirculation. The observed emission reduction was much less than predicted by the kinetics of atmospheric nitrogen oxidation at flame temperatures.

39167 (CONF-761019—, pp 111-120) **Coal—oil mixture combustion in a 45,000 LB/HR packaged boiler.** Clark, K.J. (ACUREX Corp., Mountain View, CA). Feb 1977.

From Coal-oil slurry combustion technology exchange workshop; Washington, District of Columbia, United States of America (USA) (29 Oct 1976).

In Proceedings of the coal—oil mixture combustion technology exchange workshop.

The program objectives are to demonstrate the technical and economic feasibility of retrofitting an existing oil/gas packaged boiler to burn a coal-oil mixture. We are going to be preparing fuel on site and carrying out the required boiler and burner modifications. Another important factor, of course, is an environmental assessment of the coal-oil mixture combustion, since the particular site will be burning coal for the first time. Finally, a third major objective, consistent with ERDA's desires in this program, is information dissemination and commercialization.

39168 (CONF-761019—, pp 125-161) **General Motors powdered coal—oil mixture program.** Brown, A. Jr. Feb 1977.

From Coal-oil slurry combustion technology exchange workshop; Washington, District of Columbia, United States of America (USA) (29 Oct 1976).

In Proceedings of the coal—oil mixture combustion technology exchange workshop.

With the current emphasis on lessening the dependence on foreign oil by converting all oil-fired steam generating facilities to coal, the nation faces large capital expenditures. An alternative that directly attacks this problem is pulverized coal-in-oil. In this approach, oil supplies are extended through the partial substitution of coal. Coal-oil mixtures are manufactured by first pulverizing coal to 70 percent through 200 mesh, then mixing it in No. 6 residual fuel oil. This mixture can be used in a boiler as is or with an additive. It has been estimated that the successful implementation of coal-oil mixtures can have a potential impact equivalent to 30 percent of the imported oil to the United States. This would be equal to the annual fuel consumption of 36 million cars. In addition, implementing time is only one year compared to the three to four year lead time required for new coal-fired boilers. The benefits to the United States of using coal-oil mixtures are: Extension of fuel supplies for transportation, chemical and home use; expanded use of coal; minimal capital expenditure; operating cost savings; and versatility of operation.

39169 (EPRI-FP—308-SY) **Summary evaluation of atmosphere pressure fluidized bed combustion applied to electric utility large steam generators. Executive summary.** Dowdy, T.E.; Lapple, W.C.; Kitto, J.B.; Stanoch, T.P.; Boll, R.H.; Sage, W.L.; Strom, S.S. (Babcock and Wilcox Co., Alliance, Ohio (USA). Research Center). Oct 1976. 9p. P 02/MF A01.

An atmospheric pressure fluidized-bed combustor has been proposed as an alternative to the conventional pulverized coal boiler equipped with its tailend scrubbing system. The major potential advantages of fluidized-bed combustion are the removal of SO_2 within the fluidized-bed using limestone, and the lowering of NO/sub x/ due to lower combustion temperatures. In addition, other potential advantages include high volumetric combustion rates and

high heat transfer, resulting in possible equipment size reduction. These advantages suggest that fluidized bed combustion may have application to steam generators. The purpose of this project was to collect available data and to establish, where feasible, criteria for the design of a fluidized bed combustor (FBC) steam generating system and, in addition, to identify those areas where additional activity is required. In performing this critical review, the fluidized bed steam generation process was examined with respect to six areas: Bed design, combustion of coal, heat transfer, environmental aspects, materials and economics. It is concluded that: The fluidized bed combustor is a feasible approach for producing steam to generate electricity; insufficient information presently exists to design and construct a prototype system that will have a high probability of success; an adequate economic evaluation of a fluidized bed system versus a conventional pulverized coal boiler equipped with tailend scrubbing has not been made—and should be; and it can very likely comply with existing federal SO_2 and NO/sub x/ air pollution criteria. Recommendations for further work are given.

39170 (FE—2453-3) **Technical support services for direct combustion, advanced power development, and coal conversion and utilization. Quarterly technical progress report for the period 8 June—7 September 1976.** (Mitre Corp., McLean, Va. (USA)). 1976. Contract EX-76-C-01-2453. 27p. P 03/MF A01.

The purpose of this contract is to provide planning, analytical, technical support, systems engineering support and other required services to the Division of Coal Conversion and Utilization at the direction of ERDA. Support services provided include five functional areas: Program planning and monitoring, direct combustion, advanced power development systems, liquefaction and gasification, and special tasks. Work to be performed is defined in Task Orders issued by ERDA to METREK. Work performed under the various tasks assigned is described. This involved 20 different tasks for this reporting period.

39171 (PB—260478) **Studies of the pressurized fluidized-bed coal combustion process. Phase report, Aug 1973—Aug 1975.** Hoke, R.C.; Bertrand, R.R.; Nutkis, M.S.; Kinzler, D.D.; Ruth, L.A. (Exxon Research and Engineering Co., Linden, N.J. (USA)). Sep 1976. Contracts EPA-68-02-1312;EPA-68-02-1451. 223p. (GRU—15GFGS.76). Q 10/MF A01.

The report gives results of studies of the environmental aspects of the pressurized fluidized-bed coal combustion (FBCC) process, using two experimental facilities: a new 218 kg coal/hr miniplant combustor (0.63 MW equivalent), and a 13 kg coal/hr batch combustion unit. Operating results from both facilities indicate that SO_2 emissions can be controlled to meet current EPA New Source Performance Standards for coal-fired utility boilers with either limestone or dolomite sorbents. NO/sub x/ emissions from pressurized FBCC can be controlled to 0.2 to 0.4 lb (as NO_2)/million Btu (0.30 g/million J). (GRA)

39172 (ERDA-tr—271) **Developmental proposal: preparation of final construction documents for a 100 MW coal power plant with pressure-driven fluidized bed firing.** (Bergbau-Forschung G.m.b.H., Essen (Germany, F.R.)). Aug 1976. Translation of German report. 46p. P 03/MF A01.

In order to be able to fully utilize the developmental potential of the pressure-fired fluidized layer, in a subsequent pursuance of development, the reliable operation of a gas turbine using the load of exhaust gases from a fluidized bed firing must be demonstrated. Up until now, only test results with stator blade segments have been available. The planned test plant is therefore suited to provide information concerning the operational behavior of gas turbines with high dust loads and help overcome possible difficulties by constructive measures and use of suitable materials. A successful operation of the gas turbine would open the way for a new operational area for the latter and make possible the combined gas-steam turbine process on a coal base without the intermediate stage of gasification. A cost-beneficial desulfurization of the fuel by the addition of lime in the fluidized bed would improve the competitive situation of coal in power production and enlarge the fuel base. The utilization of previously unused coal with a high sulfur content would increase the cost efficiency of the coal supply. The utilization of domestic coal, both cost beneficial and accommodating to the environment, would decrease the dependency of the Federal Republic of Germany on energy imports and lastly utilize the entire people's economy.

39173 Coal and its effective utilization in cement manufacturing plants. Bagchi, R.N. (Development Consultants Ltd., Calcutta). *J. Inst. Eng. (India), Chem. Eng. Div.;* **57**: 11-13(Oct 1976).

Cement production involves considerable fuel. The hike in oil price has made use of oil almost prohibitive in the cement industry. Thus coal becomes the single choice as fuel for this industry. But, in India, cement industry is usually fed with low quality of coal of high ash content. This seriously affects cement quality apart from its increased requirement, as coal in the cement industry is used both as a fuel and a raw material. The several possibilities of the effective utilization of coal, such as adoption of dry process for new enterprise and conversion of existing wet process plan to dry one, utilization of kiln exhaust gas, beneficiation of coal and limestone are discussed. The modern method of cement production in fluidized bed technique is also outlined because of its lesser expenditure of fuel.

39174 Coal dust injection in blast furnace. Roy, D.; Mojumder, B.N.; Ganga Rao, V.; Gupta, R.G. (Metallurgical and Engineering Consultants Ltd., Calcutta). *J. Inst. Eng. (India), Chem. Eng. Div.;* **57**: 20-24(Oct 1976).

Coke contributes a major part of the hot metal cost in an integrated steel plant. In order to reduce the coke consumption, injection of noncoking coal in the blast furnaces assumes significant part under Indian conditions particularly, when the reserves of the coking coal in the country is limited. The status of the technology in the country emphasizing the need to establish the various process parameters on the injection of noncoking coal in blast furnaces is reviewed.

39175 Effect of coal properties on selection and sizing of coal burning equipment and the design of boiler plants. Kelkar, S.S. (ACC—Vickers—Babcock Ltd., Durgapur, India). *J. Inst. Eng. (India), Chem. Eng. Div.;* **57**: 27-35(Oct 1976).

Major portions of Indian coal reserves are noncoking bituminous having high percentage of ash and low percentage of sulfur. Ash in Indian coal is abrasive and in most cases ash deformation and fusion temperatures are high. Major consumers of noncoking coals are the thermal power stations and steam raising plants. Advancement in the design of firing equipments has made it possible to burn coals having high percentage of ash, moisture and fines. The paper discusses the effect of coal properties on selection and sizing of coal firing equipment, their effect on operation of such equipment and associated boilers. Coalash having high percentage of ash and fines can be best burnt in pulverized form. Rotogrates can also handle coals having ash up to 35 percent. Travelling grate stokers are not very suitable for high ash coals. Low volatile coals are difficult to ignite. Single stage simultaneous burning of volatiles and coke permits the coals to be burnt at high rates. Stokers constitute coal burning equipment for most of the industrial plants and steam raising plants at coal mines and pulverized firing equipment for most of the thermal power station boilers. Besides coal properties, operational requirements often dictate the selection of firing equipment.

39176 Ignition of p.f. in boiler bins and ways of preventing it. Korotov, E.I.; Polferov, K.Ya. *Therm. Eng. (USSR) (Engl. Transl.);* **23**: No. 2, 19-21(Feb 1977).

Translated from Teploenergetika; 23: No. 2, 18-20(Feb 1976).

An analysis of the causes of ignition of pulverized coal showed that the chief cause in the upper section of the storage bin is the lack of exchange of the fuel. The thermal factor of self-oxidation plays only a secondary role. In the lower part of the bin the chief cause of ignition is the filtration of gas or air from the supply lines. Prevention of ignition may be achieved by rotating the fuel and by preventing the entry of air into the bin. If there is prolonged shutdown of the boiler, the bin should be quickly emptied. (JSR)

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 39048, 39086, 39692

39177 Energy crisis and coal gasification. Pings, W.B. pp 118-163 of In Fuel gases from coal. New York; MSS Information Corp. (1976).

Energy usage in the U.S. has been increasing faster than population growth. Government regulation of the price of natural gas at the wellhead began in 1954 and the price has been maintained lower than that of equivalent forms of energy; so too much of it has been used, the low prices reduced exploration, and a shortage has developed. The possibility of importing natural gas from Siberia is assessed. There are large reserves of coal, but there are environmental problems in mining it and in burning it. The potentials of alternative energy sources are considered: nuclear energy, thermonuclear fusion, geothermal energy, solar energy, wind turbines, tidal power, solar sea power plants, MHD generators, solid waste incineration, oil shales, tar sands, etc. Finally, the need and potential of energy conservation is investigated, with specific suggestions as to promising areas for conservation. (LTN)

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 39137, 39140, 39146, 39147, 39148, 39155, 39156, 39159, 39932

39178 Dust control and planned layout in the ten feet seam at holditch. Smales, T.E. (Natl Coal Board). *Min. Eng. (London);* **135**: No. 185, 669-681(1976).

This introduces the subject of dust and pneumoconiosis and explains the nature of the problem of dust control in particular seams in North Staffordshire, U.K. The method of dealing with the problem of non-approved conditions is described from planning considerations through to the operational situation. The paper is designed to show that the general environment in which men operate on and about faces can generally be improved by detailed consideration of the planned layouts and production methods to be adopted. At the end of the paper are comments which are intended to provoke consideration of dust control techniques which will be required in the future. 4 refs.

39179 Utilization potentiality of coal as a reductant for the production of sponge iron. Mishra, H.P. (Industrial Promotion and Investment, Orissa, India). *J. Inst. Eng. (India), Chem. Eng. Div.;* **57**: 65-70(Oct 1976).

With the ambitious plan of the Government of India to produce about 70 million tonnes of steel per annum towards the end of the century, the requirement of coal would be enormous. This calls for judicious planning and conservation of coal. Modern trend in steel plant practice is to use blast furnaces of capacity 10,000 to 12,000 t/day requiring superior quality coke of low ash content which will become scarce. Concerted efforts should be made to bypass blast furnace technique by adopting direct reduction for the production of metallized iron ore, that is sponge iron, and using this as feed stock in electric furnaces. Experience has shown that the use of sponge iron as feed stock for electric arc furnaces instead of the scrap available from various fabrication and steel works results in better production of alloy steels. The use of non-coking coal as reductant for production of sponge iron will help conserve coking coal for bigger steel plants. In the solid state reduction process the technological design of the sponge iron plant has to be tailored to the type of feed stock to be used, particularly iron ore and coal. In India, non-coking coal is available at close proximity to the iron ore mines containing high grade iron ore. Planning for sponge iron, utilizing large reserves of non-coking coal as feed stock therefore has considerable potentiality. India has vast reserves of high grade iron ore and comparatively meager amount of coking coal. This calls for planning for sponge iron using non-coking coal as feed stock.

PETROLEUM

REFER ALSO TO CITATION(S) 39663, 39694

39180 Future trends in supply of petroleum engineering manpower. Glenn, W.E. New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers (1976). 6p. (CONF-761008—18).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

On the basis of an evaluation of the need for petroleum engineers and the type of knowledge that they must have, the future demand-supply for graduate petroleum engineers is projected. (JSR)

39181 Report on tentative SPE metrication standards. Campbell, J.M. New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers (1976). 8p. (CONF-761008—183).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

At its meeting in Feb. 1976 in Las Vegas, the SPE Board changed the name of the SPE Symbols Committee to SPE Symbols and Metrication Committee and approved the general time goals submitted by that committee. This paper presents a tentative set of standards in accordance with that schedule. The purpose is twofold—summarize progress to date and elicit input from the SPE membership. It is the subcommittee plan that a semifinal set of metric standards be published in early 1977 in the Journal of Petroleum Technology.

39182 (PB—256634) Petroleum industry survey data tape. Data file. Flaim, T. (Cornell Univ., Ithaca, N.Y. (USA). Dept. of Agricultural Economics). 9 Jun 1976. mag tape, vp. Source tape is in EBCDIC character set. Tape can be prepared in most standard 7 or 9 track recording modes for one-half inch tape. Identify recording mode desired by specifying character set, tract, density, and parity. Call NTIS Computer Products if you have questions. Price includes documentation, PB—256635, User's Guide.

The information in the data tape described here is based on a survey of 89 petroleum companies in the United States (63 of whom responded to the survey questionnaire). The survey was designed to gather data on each major aspect of industry structure and to focus upon interactions among companies in each stage of the industry. Information was collected on a detailed geographic basis, usually being individual States or P.A.D. Districts within the U.S. and individual countries in foreign operations. Data covers the following areas: general ownership, management, and financial structure of the companies; oil and natural gas (1) well ownership and production, (2) assignments, and (3) exploratory and developmental wells; natural gas sales, purchases, processing, and gathering; petroleum refining in 1964-73; marketing; transportation and storage; foreign operations and their revenue, net worth, and ownership; uranium and coal; and, financial questions including security issues, auditing and law firms retained by the companies, and investment, revenues, costs and profits. (GRA)

39183 (PB—256635) User's guide to petroleum industry survey data tape. Locken, J.; Cole, K.; Chapman, D. (Cornell Univ., Ithaca, N.Y. (USA). Dept. of Agricultural Economics). 9 Jun 1976. 297p. NTIS $9.25.

For system on magnetic tape, see PB—256634. Continuation of Grant No. NSF-GI-41470.

The survey was designed to gather data on each major aspect of industry structure and to focus upon interactions among companies in each stage of the industry. Information was collected on a detailed geographic basis, usually being individual States or P.A.D. Districts within the U.S. and individual countries in foreign operations. Data covers the following areas: general ownership, management, and financial structure of the companies; oil and natural gas (1) well ownership and production, (2) assignments, and (3) exploratory and developmental wells; natural gas sales, purchases, processing, and gathering; petroleum refining in 1964-73; marketing; transportation and storage; foreign operations and their revenue, net worth, and ownership; uranium and coal; and, financial questions including security issues, auditing and law firms retained by the companies, and investment, revenues, cost and profits. The User's Guide contains the following sections: introduction, coding procedure and explanation of coding classification, data listing programs, discussion of each question, and job control language and a list of files on the tape. Portions of this document are not fully legible. (GRA)

RESERVES

39184 Concerning world oil resources. 6. Figures. Grenon, M. *Rev. Energ.;* **27**: No. 286, 440-445(Sep 1976). (In French).

The article points out the enormous differences between the estimates of oil resources even for the USA, which is a well prospected area, not to speck of the less well known countries. Tables of estimates of oil resources for the USA and for the world as a whole are presented. It is concluded that the total reserves of liquid and gaseous hydrocarbons amount to about 500-600 billion ton-equivalent of petroleum or 800-900 billion ton-equivalent of coal, which would suffice for over 100 years of consumption.

GEOLOGY AND EXPLORATION

39185 (ORNL/Sub/38283—75/3) Salt dissolution in oil and gas test holes in central Kansas. Part III. Salt dissolution in oil and gas test holes in the Chase-Silica Oilfield, Barton and Rice Counties, central Kansas. Walters, R.F. (Walters Drilling Co., Wichita, Kans. (USA)). Jun 1975. Contract W-7405-ENG-26;SUB-PO-78X-38283V. 60p. Dep. NTIS $4.50.

In the Chase-Silica Oilfield (135.3 square miles), all of the 4845 oil and gas test holes drilled completely through the Hutchinson Salt Member of the Permian Wellington Formation (depths of 900 ft on east to 1000 ft on west). The salt is 250 ft thick in the structurally highest areas above buried Precambrian quartzite hills; 300 ft over most of the oil-producing area; and over 350 ft thick in synclinal areas. The salt section includes nonevaporites (shale, rare siltstones) in beds having a thickness of one foot or more in amounts of 17 percent (east) to 31 percent (west). When drilled in the 1930's by early rotary rigs which took 24 days to reach 3250 feet, the salt dissolved to hole diameters near or exceeding 5 feet. Cased hole gamma neutron logs recorded some 10 years later in such holes have a pronounced gamma shift to the right (radiation increases) opposite the lower cleanest portion of the salt; this is interpreted as washed-out holes packed with shale which fell when fluid levels behind the casing settled downward. No salt dissolution takes place after drilling ceases in either cased oil wells or dry holes, if plugged at all, except three holes where excessive post-drilling salt dissolution caused slow surface subsidence. In the Panning No. 11-A which drilled 90 ft alluvial sand and gravel, subsidence was followed by 12 h of sudden dramatic collapse, leaving a 300-ft dia lake which is still 64 feet deep sixteen years later. The 694 remaining oil wells in this 260 million barrel oilfield are nearing depletion. (DLC)

39186 Use of tracers in diagnosing interwell reservoir heterogeneities: field results. Wagner, O.R. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—117).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

A suite of chemical and radioactive tracers was proven for tracing the interwell flow of both gas and water and in identifying sweep problems in five field tests. The tracer performance in these field tests validated the usefulness of a tracer prediction model in providing guidelines for tracer program designs. Qualitative agreement was obtained between the model predicted performance and the actual tracer performance in two wells in a West Texas Project where the reservoir stratification was known from prior waterflood history. The tracer information obtained from these field tests has provided a better understanding of these reservoir interwell anatomies. Further, should these reservoir areas be committed to a subsequent tertiary oil recovery process, the tracer information already obtained will be useful to the design, control, and interpretation of that recovery process.

39187 Log evaluation in the California Miocene formations. Heflin, J.D.; Neill, B.E.; DeVries, M.R. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 18p. (CONF-761008—94).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

The increasing demand for oil has extended the search for new sources into formations that in the past have proven difficult to evaluate and profitably produce. The depositional facies belonging to the Miocene epoch in California have historically posed difficult evaluation problems with the Monterey Shale causing the most difficulties. This formation is playing an important role in the development of California offshore reserves. It is characterized by thick siliceous and calcareous organic sediments. Vital to evaluating reservoirs located in this series is the location of fractured zones and the accurate determination of porosity. This can only be accomplished by identifying the lithologies encountered and by the proper interpretation of measurements made with available logging devices. An open hole logging suite and a computer program tailored specifically to solving problems unique to this series has been developed and successfully used.

39188 Detection and location of two parallel sealing faults around a well. Tiab, D.; Kumar, A. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—112).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Although there are methods to detect the presence and location of one sealing fault in the vicinity of a producing oil or gas well by transient well pressure data, such methods generally do not show interpretable characteristics in presence of multiple faults. It is shown that for a well between two parallel sealing faults a log-log plot of time rate of change of well pressure, deltap/sub w//deltat, vs time provides a unique behavior to detect as well as locate the distance to each fault. The log-log plot further allows the use of type-curve matching technique to determine the kh product.

39189 Gravity and capillarity effects on the matrix imbibition in fissured reservoirs. du Prey, E.L. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 16p. (CONF-761008—148).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

This paper attempts to assess the laboratory experiments used to scale gravity and capillarity, the two active forces in the recovery process from matrix blocks in fissured reservoirs. We performed imbibition tests which show a great discrepancy between the scaled recovery curves corresponding to different block sizes. Several reasons may be considered to explain the failure of scaling rules: flow boundary conditions, local heterogeneities, and instabilities in the water sweep.

39190 Field application of pressure buildup tests, Jay—Little Escambia Creek Fields. Langston, E.P. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—149).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Pressure buildup tests are a valuable reservoir description and well evaluation tool in the Jay-Little Escambia Creek (Jay-LEC) Fields of Alabama and Florida. Four practical applications are demonstrated from the results of forty-three tests conducted to date. A comprehensive coring program coupled with high quality, consistent test data have made such applications possible. Buildup tests have provided the basis for arithmetic averaging of core data to determine effective reservoir permeability and are a significant guide in the planning and evaluation of workovers. Remedial action taken as a result of such tests will substantially improve waterflood conformance. These tests have also provided information that are an aid in the solution of reservoir description problems.

39191 Contribution of seismic reflection to petroleum exploration in Angola onshore exploration. Fortems, G. (Petrofina SA, Brussels). *Ann. Mines Belg.;* No. 7-8, 591-612(1976). (In French).

The seismic reflection method, a standard reconnaissance tool in petroleum exploration, has contributed to the assessment of the potential of the Lower Congo Basin in Angola. Owing to the generally small size of post salt anticlines, and the complex, highly faulted internal structure of narrow pre-salt grabens, dense seismic reflection coverage of structural anomalies has proved indispensable for accurate definition and optimum choice of well locations. Seismic work, which began onshore in December 1966 and continued through to 1975, has attained a totalized profile coverage of 3,600 km over a surface of 3,000 km^2, representing 52 seismic crew/month. The subtlety of structural problems suggested by the result of the reconnaissance phase, instigated a research effort aimed at improving seismic data quality. This was achieved, essentially by the use of more sophisticated recording equipment and field methods, supplemented by increasingly refined data processing. The quality and density of seismic reflection coverage has permitted an exploration success ratio of 35 percent (6 fields discovered among the 17 onshore structures tested to date). In addition, detailed seismic on proven fields, has considerably facilitated development work.

39192 Generation of hydrocarbons in the process of lithogenesis of sediments. Trofimuk, A.A. Novosibirsk, USSR; Izdatel'stvo Nauka (1976). 197p.

All sequential stages of the transformation of organic material from diagenesis to the original metamorphism in the strata for the genesis of petroleum and gas were examined. New data, characterizing the quantitative aspects of the process of petroleum formation, were obtained. In agreement with these data the petroleum and gas productivity of organic material was evaluated significantly higher than was proposed earlier. The subsurface zonality of petroleum and gas formation, the conditions favoring the development of the principal phases of petroleum formation, and the quantitative aspects of this process were made more precise on the basis of a large volume of data. The principal phases of gas formation, occurring usually in deep zones of 3.5 to 5 km, were defined. It was established that in this zone gas of the order of 10 percent was generated from the original mass of sapropel organic material. The relation between the regularities of the generation of petroleum and gas and their distribution in deposits was shown. These regularities can be used in exploration.

39193 Convection in fractured reservoirs: numerical calculation of convection in a vertical fissure, including the effect of matrix-fissure transfer. Peaceman, D.W. New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers (1976). 28p. (CONF-761008—182).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

In a fractured reservoir undergoing pressure depletion, evolution of gas at the top of the oil zone leads to an unstable density inversion in the fissures. The resulting convection brings heavy oil into contact with matrix blocks containing light oil, and results in the transfer of dissolved gas between matrix and fissure in the undersaturated region of the oil zone. To provide a better understanding of this process, numerical solutions were obtained to the differential equations that describe convection in a vertical fissure and include the matrix-fissure transfer. The numerical procedure is an extension of the method of characteristics for miscible displacement problems in two dimensions. The effect of gas evolution in the upper portion of the oil zone is also included in the numerical model. Calculations for a vertical fissure of rectangular shape, with an initial sinusoidal perturbation of an inverse density gradient, show an initial exponential growth of the perturbation that agrees well with that predicted from mathematical theory. Calculations for a vertical fissure having a similar, but slightly tilted, rectangular shape, and with an initial correspondingly tilted, inverse density gradient, show that the effect of the matrix-fissure transfer parameters on the time for overturning can be correlated quite well by curves obtained from mathematical perturbation theory. The most realistic calculations were carried out for the same vertical fissure having a slightly tilted rectangular shape, with declining pressure at the apex and gas evolution included in the gassing zone. For practical ranges of the matrix-fissure transfer parameters investigated, it is concluded that saturation pressure depression will be significant. A preliminary correlation for this p/sub b/ depression was obtained. The fissure thickness was found to affect the p/sub b/ depression significantly.

39194 Evaluation of dry hole probability associated with exploration projects. Wansbrough, R.S.; Price, E.R.; Eppler, J.L. New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers (1976). 16p. (CONF-761008—38).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

A number of authors have discussed the application of Monte Carlo simulation methods to the economic evaluation of exploration ventures. The ultimate results of such simulation will be directly proportional to the dry-hole risk associated with the venture. This paper deals, first, with a method of evaluating dry-hole risk and, second, with a method of minimizing the impact of bias or emotion on the probability estimates used. It is suggested that the occurrence of hydrocarbon reservoirs requires the simultaneous occurrence of a means of entrapment, porous and permeable rock, and hydrocarbon accumulation. In evaluating the probability of occurrence of any one of these events, the explorationist may have more than one independent analytical method at his disposal. To evaluate the probability of occurrence of accumulation, for example, the explorationist may have statistical data regarding the occurrence of hydrocarbons in traps within a particular formation, and may also have "bright spot" or seismic amplitude data that each provide independent indications of an accumulation in the prospect considered. The method proposed makes use of statistical-set theory, first, to combine independent indicators of each of the required three events (trap, porous and permeable rock, accumulation) and, second, to evaluate the probability of the simultaneous occurrence of the three events.

39195 Method for detecting and locating sand producing zones in friable, unconsolidated sandstone formations of subterranean formations. Sparlin, D.D.; Fertl, W.H.; Young, G.C. (to Continental Oil Co.). US Patent 3,949,220. 6 Apr 1976. Filed date 4 Oct 1974. 8p.

A method is claimed for locating and identifying sand producing zones in friable, unconsolidated sandstone formations of a subterranean reservoir traversed by a well bore. The method comprises the following steps: (a) introducing into said reservoir through said well bore, a radioactive material which is preferentially retained in the porous portions of the formation surrounding said well bore; (b) passing a radioactivity detection means through the well bore and recording the measurement of radioactivity of said reservoir; (c) returning the reservoir to production; and, (d) passing a radioactivity detection means through said well bore and recording the measurement of radioactivity of said formation for a second time and correlating the measurements of radio-activity of each measurement with measurement of depth to thus locate sand producing zones in said reservoir. 11 claims.

39196 Ground vibrations due to seismic detonation of a buried source. Awojobi, A.O. (Univ. of Lagos, Nigeria); Sobayo, O.A. *Int. J. Earthquake Eng. Struct. Dyn.;* 5: No. 2, 131-143(1977).

The problem of vibrations at the free surface of an elastic half-space due to detonation of a buried source is studied from the viewpoint of the geophysical seismic technique employed in oil exploration. The fundamental assumption of the theory, therefore, is that the pressure at the source is impulsive and a Dirac delta function of time. The depth of the source below the surface of the medium is considered in the present theory as an additional parameter which has hitherto made the buried source problem formidable and, therefore, has limited almost all previous works to the relatively easy problem of surface blasting. An exact formulation is presented by dividing the half-space into a stratum above the level of the buried source and a half-space below it. For boundary conditions at the interface, it is assumed that the vertical displacement and shear stress at the level of the source are continuous while the direct stress is discontinuous. A numerical evaluation of the contour integration in the analysis is presented for the components of vibrations at any point of the free surface for a Poissonian medium. The analysis provides a theoretical justification for the interesting results obtained from field experiments recorded in an earlier work.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 39186, 39188, 39190, 39570, 39695, 39917, 39971

39197 API recommended practice for testing oil-well cements and cement additives. Dallas; American Petroleum Institute (1974). 57p. (NP—21794).

This recommended practice is under the jurisdiction of the API Committee on Standardization of Oil-Well Cements. The purpose is to define (1) the mandatory tests of Par. 2.6, Spec 10A (a companion API recommended practice), and (2) various nonmandatory test requirements for evaluating those physical properties of cement having special importance to the oil and gas industries.

39198 API recommended practice for standard procedure for testing drilling fluids. Dallas; American Petroleum Institute (1974). 33p. (NP—21796).

This recommended practice is under the jurisdiction of the API Committee on Standardization of Drilling Fluid Materials. This purpose is to provide standard procedures for the testing of drilling fluids. It is not a detailed manual on mud control procedures. It should be remembered that the agitation history and temperature of testing have a profound effect on mud properties.

39199 API recommended practice for production facilities on offshore structures. Dallas; American Petroleum Institute (1974). 25p. (NP—21798).

This Recommended Practice for Production Facilities on Offshore Structures is under the jurisdiction of the API Committee on Standardization of Offshore Structures. It contains engineering guidelines and suggested installation practices pertaining to production equipment on offshore structures. These guidelines are based on sound engineering design principles and industry experience gained during the development of offshore oil and gas resources. This recommended practice is directed toward maximum safety of personnel, compliance with regulations, prevention of pollution for preservation of the environment, protection of the production facility and accessibility for operation and maintenance.

39200 Artificial lift for oil wells. Morgan, T.H. US Patent 3,941,510. 9 Aug 1974. Filed date 14 Apr 1975. vp.

An artificial lift apparatus for a hydrocarbon producing well having a well head and a well casing therein is claimed.

39201 API specification for rotary drilling equipment. Dallas; American Petroleum Institute (1975). 77p. (NP—21793).

American Petroleum Institute (API) specifications are published as an aid to procurement of standardized equipment and materials. This specification covers dimensional requirements on drill-stem members (except drill pipe), including threaded connections, gaging practice, and master gages therefor. It also covers dimensional requirements on small diameter work strings, rotary tables, shafting, slush pump components, rotary hose, and brake blocks. Also included, as appendices, are recommended practices on (1) care and use of regional master, reference master, and working gages, (2) slush pump maintenance, (3) rotary hose, and (4) lubrication of rotary shouldered connections.

39202 Artificial lift for oil wells. Morgan, T.H. US Patent 3,941,511. 4 Jun 1975. Filed date 31 Jan 1975. vp.

An artificial lift apparatus for a hydrocarbon producing well having a well head and a well casing therein is claimed.

39203 Theory for the pressure transient analysis in naturally fractured reservoirs. Najurieta, H.L. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—11).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

An equation to calculate the unsteady-state pressure behavior within the fractures of a fractured reservoir is presented in this paper. The equation, an approximate solution for the theory proposed by de Swaan, allows the treatment of fractured systems with different geometry, and describes completely the characteristic pressure test curve of a fractured reservoir, including the transitional zone. Particular attention is given to layer-like and block-shaped fractured reservoirs with unsteady-state pressure behavior within the rock matrix. The approach presented here is useful for pressure buildup or drawdown data analysis and for pressure interference tests from fractured reservoirs. It is shown that fracture pressure, in a uniformly fractured reservoir, depends on four parameters only, and a technique for their determination from the pressure variation curve is proposed. Such technique can be applied, for example, to a pressure buildup curve to obtain fractures transmissibility, fractures to matrix storage ratio and a parameter that gives information about block size and diffusivity. Another technique for estimating total fluid storage in the test area, which makes use of the above mentioned parameters, is also presented.

39204 Vertical fracture height: effect on transient flow behavior. Raghavan, R.; Uraiet, A.; Thomas, G.W. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 16p. (CONF-761008—12).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Although a number of studies have examined the performance of vertically fractured wells, no analytical study has examined the effect of fracture height on transient flow behavior and production capacity. The purpose of this paper is to fill this gap in the knowledge of fractured well behavior. An analytical study is presented of constant rate production from a well containing a single vertical fracture of finite height which is less than the formation thickness located at any position in an infinitely large reservoir with impermeable upper and lower boundaries. Characteristics of dimensionless pressure drop vs. dimensionless time data are examined for both uniform flux and infinite conductivity fractures. Two fracture

locations within the producing interval are considered. Curves are also presented to calculate the additional pressure drop that results as a consequence of the fracture height being less than the formation thickness. Other parameters of interest that are examined here are: ratio of vertical to horizontal permeability, ratio of fracture height to formation thickness and fracture length. The application of theoretical results to well test analysis is also discussed.

39205 Automatic liquid level monitor for pumping wells. Godbey, J.K.; Dimon, C.A. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 8p. (CONF-761008—15).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

The Automatic Liquid Level Monitor digitally measures and records the depth to the liquid, the time of the measurement, and the casing pressure in a well at preselected time intervals. These data are used to calculate the bottom-hole pressure to obtain the buildup and drawdown characteristics of a pumping well. The analysis of these curves yields a measure of the formation pressure, permeability, skin factor, productivity index, pump efficiency, and the determination of the optimum pump cycle-time of intermitted wells. A complete description of the monitor, its use in the field, and examples of results are presented in this paper.

39206 Production logging through the annulus of rod-pumped wells to obtain flow profiles. Hammack, G.W.; Myers, B.D.; Barcenas, G.H. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 8p. (CONF-761008—23).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Pumping well production profiles run under dynamic conditions represent the best opportunity for observing downhole conditions under normal flow behavior. Information from pumping well production surveys in multiple zone completions may be valuable in identifying water producing zones, gas, high GOR intervals, and nonproductive intervals. In some instances, production profile information has proved helpful in the recompletion of offset wells. A $^{7}/_{8}$-inch OD production combination logging tool can be run down the tubing-casing annulus in pumping wells with annulus clearances as small as 1.2 inches. This eliminates the need for running the logs through tubing after swabbing, or replacing the tubing string with a smaller diameter, and prevents alteration of stabilized well pumping conditions. The problem of the wireline wrapping around the tubing has been minimized by running the tools in and out of the hole with the well pumping.

39207 Reduce power and maintenance costs of power fluid conditioning units by improving overall operations. Justus, M.W. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 16p. (CONF-761008—24).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Single-well hydraulic pumping units are commonly called Power Fluid Conditioning Units (PFCU). The power cost per barrel of fluid lifted with a PFCU was reduced significantly by the installation of a four-speed transmission and a new style low-volume subsurface pump. The changes provided the flexibility necessary to obtain economically maximum production from both low and high volume wells. The hydrocyclones were resized for proper operation which reduced the volume of abrasive solids in the power fluid. When the solids load was reduced, the operating life of the hydraulic pump and engine was increased.

39208 Seeking a solution to sand control. Durrett, J.L.; Golbin, W.T.; Murray, J.W.; Tighe, R.E. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—140).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Sand production and its control is a major production problem encountered in almost all fields which produce from unconsolidated sandstone reservoirs. This paper shows how one company significantly improved their sand control operations through careful application of existing techniques.

39209 Maximum permissible drillbit weight from drillcollars in inclined (directional) boreholes. Mitchell, B.J. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—114).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

A discussion of the buckling of drill collars and drillpipe in inclined (directional) boreholes is presented for the purpose of selecting maximum drillbit weights from drill collars such that the section of the drillpipe within the drillstring above the drill collars will not be buckled. The theories of A. Lubinski, R. Hoch, and the work of M. Rollins pertinent to drill-collar applications are reviewed. The mechanics of drill-collar and drillpipe bending and buckling in inclined boreholes and long-standing misconceptions are discussed. A mathematical equation for the analytical calculation of a maximum permissible drillbit weight from drill collars in inclined (directional) boreholes is derived and presented with solved example problems. A convenient nomograph is given.

39210 Preparation and testing of partially hydrolyzed polyacrylamide solutions. Foshee, W.C.; Jennings, R.R.; West, T.J. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 20p. (CONF-761008—136).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

The evaluation of a mobility control polymer requires that proper laboratory techniques be followed if meaningful results are to be obtained. New procedures are presented and existing procedures are reviewed to aid in the measurement of properties related to performance of polyacrylamide solutions. In addition to mixing and filtration techniques, the measurement of polymer concentration, thermal stability, core testing, and other factors relating to mobility control in the reservoir are discussed.

39211 Tertiary oil recovery with cellulose derivatives as water thickeners. Falk, D.O.; Norton, C. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 16p. (CONF-761008—137).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

A large number of cellulose derivatives were investigated for the effects of gram molecular weight, nature of substitution, and control of substitution on their respective performances as water thickeners in the mobility buffer in the Maraflood oil recovery process in laboratory 3" x 2' linear Berea cores. The best performances were obtained with carboxymethylcellulose (CMC) derivatives of one million gram molecular weight, uniformly substituted to about 0.7-0.9 of a total 3.0 with sodium carboxymethyl groups on the glucose hydroxyl functions. The best CMC tertiary oil recoveries compare quite favorably with results obtained with Dow 700 partially hydrolyzed polyacrylamide (PHPA) and Kelzan MF xanthan gum.

39212 Some aspects of mobility buffer design in surfactant flooding. Szabo, M.T. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 16p. (CONF-761008—138).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

A study was made of the movement of 1-PV slugs of polymer solutions in cores that had been previously treated with sulfonate and then brine flushed. The data revealed premature polymer breakthrough. These results were attributed to low polymer retention and an inaccessible pore volume to polymer flow. The shapes and absolute values of the polymer breakthrough curves depended on the type of polymer and sulfonate used. When no brine flush followed the sulfonate solution, an even earlier polymer breakthrough was observed. This phenomenon was thought to be mainly related to a polymer-sulfonate interaction. Solutions of ten chemically different polymers were blended with solutions of four sulfonates. Upon standing, these mixtures separated into two layers—a top layer highly concentrated in polymer, and a bottom layer containing a higher sulfonate concentration. Viscosities, fractional volumes, and interfacial tensions to oil of the separated layers depended on the particular polymer-sulfonate system. It was also established that these layers are separate phases with a measurable but very low interfacial tension at the phase boundary. The effect of salinity and polymer concentration on phase separation was also studied. Phase separation of polymer-sulfonate systems also occurred in Berea core flow tests, resulting in differing mobilities of the separated phases. This phenomenon can result in a low recovery efficiency in low tension surfactant flooding. An improvement in tertiary oil recovery efficiency was, however, achieved by using low salinity in the mobility bank.

39213 Development of lignosulfonate gels for sweep improvement. Felber, B.J.; Dauben, D.L. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 8p. (CONF-761008—139).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

The development of a lignosulfonate gel system for improving sweep efficiency is discussed. The gel mixture is injected as a low viscosity fluid into a loose streak. After gelation occurs, subsequently injected fluids are diverted into lower permeability intervals.

The developed system is composed of 95 percent or more water, ammonium lignosulfonate and a mixed activator of sodium dichromate and salt. Laboratory studies show that lignosulfonate gels exhibit the following properties: (1) Long gel times can be designed. For example, gel times up to 2½ months were obtained at 190°F. (2) Gel strength can be controlled to produce the level of flow reductions required for a particular application. Controlled flow reduction, rather than complete flow blockage, is needed where the loose streak may contain appreciable amounts of oil recoverable by further waterflooding or by a miscible flood. (3) Available injection waters, even highly saline, can be used for mixing the gel solutions. (4) Lignosulfonates, with no activator, gel when exposed to temperatures in the range of 300 to 450°F. A fluid with these properties should be useful in controlling sweep in high temperature reservoirs or steamfloods.

39214 Optimizing waterflood recovery in a mature waterflood, the Fullerton Clearfork Unit. Stiles, L.H. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—150).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

After a detailed study of 12 years' performance of the Fullerton Clearfork Unit, a special study group recommended major operating changes which will increase ultimate oil recovery 22 million barrels. New techniques included a simplified waterflood model and a statistical approach to measure reservoir continuity. Evaluation of alternate plans with these tools indicated the need for infill drilling and a closer spaced pattern.

39215 Enriched miscible flooding: a case history of the Levelland Unit Secondary Miscible Project. Brannan, G.; Whitington, H.M. Jr. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 8p. (CONF-761008—165).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

This paper reviews the performance of a hydrocarbon miscible displacement process in the Levelland Unit, Levelland Field, Hockley County, Texas. The Levelland Unit Secondary Miscible Project consists of 28 injectors and 40 gross (28 net) producers that comprise a portion of the Levelland Unit operated by Amoco Production Company. The reservoir is a typical West Texas dolomite with a gross pay interval as large as 250 ft and a net pay of 100 ft. Cyclic injection of rich gas and water has been in progress for three and one-half years. Enriched gas injection is projected to be continued until mid-1977 after which the rich gas will be chased with residue gas alternately injected with water injection. After miscibility is lost, the gas injection will be discontinued and the project will be flooded with water to its economic limit. Extensive data are being collected to monitor this project. No significant operational problems have developed other than an unexpected decrease in water injection rate following the initial cycle of rich gas injection and persisting for subsequent water cycles. Rich gas breakthrough has occurred but it has not been severe (5 percent of the cumulative injected volume). Almost 11 BCF of solvent gas has been injected to date. This is approximately 9.0 percent of the hydrocarbon pore volume. Reservoir pressure is being maintained above the minimum miscibility pressure and the injection fluid is well within the design limits. Oil production has more than doubled from 850 BO/D in 1971 to 1850 BO/D in 1976. The project is experiencing response but peak response has not yet been reached. Based on performance indications to date, this project will be an economic success.

39216 Performance history and operation of two Minnelusa reservoirs: West Semlek Field, Crook County, Wyoming. Tholstrom, K.V. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—170).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

The West Semlek Field, operated by Terra Resources, Inc., consists of two separate Minnelusa reservoirs of nearly equal size. A natural water drive is present in the southwest reservoir. A fluid expansion/solution gas drive controlled primary from the northeast reservoir which was unitized in 1972. A polymer flood was started in this NE segment during September, 1973. Minnelusa-produced water from the southwest reservoir is used for supply by the Unit. The Semlek West Unit is the only Minnelusa polymer project in Wyoming out of seven currently in operation which uses produced water for injection. Recent studies show that the ultimate recovery efficiency for both reservoirs will be about the same. The polymer program has been convincingly successful in improving flood performance and total oil recovery.

39217 Successful low tension waterflood two-well test. Murphy, C.L.; Thiede, D.M.; Eskew, J.O. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 16p. (CONF-761008—176).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Mobil's Low Tension WaterFlood (LTWF) process was successfully tested in the West Ranch field in south Texas in 1974. The LTWF process reduced the oil saturation to about 5 percent of the pore volume in the swept area. Test results show that it is possible to flush reservoir brine from the 41A formation and replace it with low salinity water. Chemical requirements under dynamic reservoir conditions were established.

39218 Petroleum sulfonate utilization in enhanced oil recovery systems. Knaggs, E.A.; Nussbaum, M.L.; Carlson, J.B.; Guenzani, R.C. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 16p. (CONF-761008—177).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Petroleum sulfonates are currently being evaluated extensively in surfactant enhanced oil recovery processes in laboratory studies, pilot field trials, and in semicommercial field tests. Consideration of surfactant manufacturing, product availability projections, product properties and laboratory oil recovery tests among available types of petroleum sulfonates establish that those produced directly and economically from abundantly available petroleum refinery feedstocks can be produced in volume to meet oil industry requirements. The diversity of crude oils and reservoir constraints make it desirable to tailor surfactant systems to optimize oil recovery.

39219 Bottom-hole assembly analysis utilizing the finite element method. Millheim, K.; Jordan, S.; Ritter, C. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—113).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

The finite-element method is used to analyze typical bottom-hole assembly configurations for building, dropping, and holding angle. Using this technique, the reactive or side forces are easily determined and the directional tendency of a given assembly can be assessed. Displacement profiles of the collars from the centerline are predicted. Stress states within a given assembly are also provided. The MARC General Purpose Finite Element System is employed in the solution of the various bottom-hole assembly arrangements. A specially developed gapping element in conjunction with a beam element is used to account for the changes in stiffness introduced when borehole contact is made. Curvature forces due to large displacement (geometric nonlinear) effects are also predicted where applicable. The basic idea underlying the value of a general purpose system is that there exists a wide class of structures requiring solution with an integrated approach. Although parametric studies on bottom-hole assemblies may be less economical with this concept, the coding can be specialized to run at competitive levels for routine parametric studies involving numerous repetitive cases. With this option, new designs and complex individual cases not amenable to the special purpose code are solvable without modification. Checking of alternate mathematical techniques for the same class of problem can be accomplished using the general purpose code.

39220 Application of p'/sub D/ function to interference analysis. Tiab, D.; Kumar, A. New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers (1976). 8p. (CONF-761008—72).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

A systematic study of the p'/sub D/ function, or the time rate of change of pressure, is presented. p'/sub D/ can be displayed as a family of curves on one graph for various r/sub D/. Dimensionless time and distance limits are established to determine when a line source p'/sub D/ provides a good approximation to a finite radius wellbore, p'/sub D/. The p'/sub D/ function exhibits a maximum value of 0.73576 at t/sub D//r²/sub D/ = 0.25. An example calculation is presented to show the use of p'/sub D/ in determining transmissibility (kh/μ) and storage (phich) values between a well pair from interference data.

39221 Oilfield machinery export data. Abrahams, E.D.; McDonald, E.J. Washington, DC; Bureau of Domestic Commerce (1976). 19p. (NP—21792).

This publication summarizes (in tables) data on trends in U.S. export sales that indicate opportunities available to U.S. oilfield machinery manufacturers. The total value of U.S. oilfield machinery exports rose sharply in 1975 to $1.483 billion, up 65% from $901 million in 1974. This performance continued an upward trend marked by a 54% increase from the 1973 level of $586 million. A single category, Parts, Accessories, and Attachments, n.e.c., for Well Drilling Machines, accounted for 71% of 1975 exports or $1.058

billion. The next three categories were Oil and Gas Field Wire Line and Downhole Equipment and Accessories, n.e.c., $96 million; Oil Well Drilling Machines, Rotary Type, $86 million; and Trucks, Nonmilitary, with Derrick Assembly, Winches, and Similar Equipment for Drilling, New, $67 million. Singapore was the leading destination country for oilfield machinery exports in 1975. With $144 million, Singapore easily retained the front running position over Algeria's $118 million. Rounding out the top ten were the United Kingdom ($106 million), Iran ($89 million), Canada ($68 million), Japan ($64 million), Norway ($59 million), netherlands ($53 million), Indonesia ($48 million), and the United Arab Emirates ($47 million). Combined these ten countries received 54% of the total U.S. exports in 1975. Altogether, thirty countries each received at least $10 million in U.S. oilfield machinery exports.

39222 Tekhnologia mekhanizirovannoi dobychi nefti. (Technology of mechanized petroleum extraction). Repin, N.N.; Devlikamov, V.V.; Yusupov, O.M.; D'yachuk, A.I. Moscow; Nedra (1976). 175p.

The results of studying the operation of underground well equipment are discussed. Recommendations are made on the selection of the optimum development regime for a well with consideration of the possible complexities because of gas-lift pumps, insert pumps, and submerged electropumps. Possibilities of operating flooded wells are examined. Methods of preventing precipitation of paraffin and salts are discussed.

39223 Ekspluatatsiya neftyanykh mestorozhdenii v oslozhnennykh usloviyakh. (Exploitation of petroleum deposits under extreme conditions). Maksimov, V.P. Moscow; Nedra (1976). 239p.

By use of the example of the petroleum-productive region of western Siberia, a series of questions dealing with the exploitation of petroleum, gas-gathering, and injection wells under extreme conditions of geological, climatic, or technological conditions is examined in detail. Special attention is given to the selection of the exploitation method, optimization of the operation of the well, and the engineering equipment. Experimental-construction studies on the most advanced techniques for petroleum recovery are reported.

39224 Unsteady-state flow behavior for a well near a natural fracture. Cinco L., H.; Samaniego V., F.; Dominguez A., N. New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—127).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

A mathematical model was developed to study the transient flow behavior for a well near an infinite conductivity vertical, nonintersecting, natural fracture in an infinite slab reservoir. A slightly compressible fluid was considered. Results when plotted as a function of a dimensionless time follow at early times a straight line of 1.151 slope characteristic of radial flow. After this radial flow period, the well pressure behavior starts to be affected by the natural fracture and this causes a negative pseudo-skin factor, which is a function of time, and becomes a constant for large values of time, giving a second 1.151-slope straight line. This pressure behavior is similar to the one predicted by the models of Warren and Root and de Swaan for a uniform naturally fractured reservoir. Results from interference tests, for reservoirs having a natural fracture, show that it is impossible to characterize uniquely the reservoir by means of the transient pressure test data alone. An integrated approach or transient pressure test data registered at several observation wells can be used for a unique characterization. From these tests, underestimation or overestimation of the reservoir parameters could result, depending on the location of the observation well relative to the natural fracture.

39225 Simplified method for predicting oil recovery by steamflood. Gomaa, E.E. New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—167).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Numerical simulation was used to determine the effects of various parameters on steamflood oil recovery. The results indicated good correlation between the latter and each of the variables; injection rate, reservoir thickness, injected steam quality, net/gross ratio, and mobile oil saturation. A set of simple nomographs was constructed from these correlations expressing recovery as fraction of original mobile oil in terms of net heat injected per acre foot of rock for different values of mobile oil saturation. A chart was also prepared for predicting vertical heat losses from the reservoir to overlying and underlying strata. Cumulative steam oil ratio was correlated as a function of mobile oil saturation, reservoir thickness and net/gross ratio. The method was applied to an actual steamflood project and the predicted results were in good agreement with observations.

39226 Stability of moving combustion fronts in porous media. Armento, M.E.; Miller, C.A. New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—168).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

The stability of moving combustion fronts during underground combustion processes is analyzed. The behavior of small deformations in front configuration is studied using linear stability theory and relatively simple models of the combustion processes. In this way the main physical phenomena which influence stability can be clearly distinguished. For wet combustion processes, where both air and water are injected, front stability is affected not only by the ratio of the mobilities of fluids flowing ahead of and behind the front, but also by heat transport near the front and by expansion accompanying vaporization of water at the front. Even more interesting is a "reverse mobility" effect predicted by the analysis. Under some conditions at relatively high air to water injection ratios, fluid flow and the heat produced by combustion interact in such a way that normally "favorable" mobility ratios become unfavorable. That is, existence of a low mobility in the region of two-phase flow of air and water behind the front can actually promote front instability. For dry combustion the heat transport and reverse mobility effects on stability do not occur and the combustion fronts are typically neither highly stable nor highly unstable, i.e., the effective mobility ratio is near unity.

39227 Wilmington Townlot Unit: waterflood implementation and response. Nelson, K.C. New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers (1976). 8p. (CONF-761008—169).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

The 1700-acre Wilmington Townlot Unit is situated in the urban Wilmington area of the City of Los Angeles. In the early 1960's Exxon Company, U.S.A. evaluated the area for possible secondary recovery waterflood operations. Initial studies were encouraging, but also showed several obstacles to implementing a successful waterflood project. The Townlot area consisted of more than 300 leases with several thousand royalty owners and more than 30 operators. Reservoir sands were pressure depleted, unconsolidated, lenticular, and contained crude with viscosities up to 150 centipoise. This paper summarizes the reservoir study which led to unitization, describes the waterflood pattern selected and the facilities installed, and discusses reservoir response achieved after three years of injection.

39228 Practical use of modern well test analysis. Ramey, H.J. Jr. New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers (1976). 22p. (CONF-761008—175).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Analysis of short time well test data by log-log type curve was introduced in 1970. The first type curve concerned the wellbore storage effect with damaged permeability in an annular shaped region adjacent to the sand face. Later type curves for vertical and horizontal fractures were added. Practical experience with these curves now indicates a great deal of useful information may be extracted from complete matching of both log-log and conventional semi-log curves. Examples include almost certain detection of the correct semi-log straight line, and the detection and correction of errors in data. On the other hand, some early claims for log-log type curves appear to be incorrect. The purpose of this paper is to summarize useful findings to date with field case illustrations.

39229 Analysis of the physical mechanisms in surfactant flooding. Larson, R.G.; Hirasaki, G. New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers (1976). 20p. (CONF-761008—179).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

A model has been developed to represent the physical displacement mechanisms of tertiary oil recovery with an aqueous phase surfactant flood. The chemical aspects are not modeled. In particular, to use the model, the residual oil saturation in the presence of surfactant must be specified. This model has been used to investigate the relationship between the system parameters (e.g., mobility ratio, partition coefficient, adsorption) and the performance variables (e.g., oil cut, chemical breakthrough, recovery efficiency at breakthrough). The model is an extension of the Buckley-Leverett analysis for flow of two fluids in a system in which composition as well as saturation is a variable. The model assumes a homogeneous, one-dimensional system, the absence of dispersion, equilibrium mass transfer, and constant composition injection (infinite slug). The analysis applies to systems of two mobile phases (oil and water) and one immobile phase (reservoir rock) in which three components (oil, water and chemical) may transfer to the rock. Conditions sufficient for "self-sharpening" are presented in which only the initial and the

injected compositions persist in the system. From this model, fourteen dimensionless parameters affecting oil recovery are isolated. The effects of the most significant parameters on oil recovery are plotted at constant values of the other parameters. In addition, the joint effect of several pairs of the parameters on oil recovery are plotted. Values of the parameters for Berea cores were estimated from experimental data. Using these values, the effect of the partition coefficient and the mobility ratio on chemical flood performance predicted by the model compared favorably to results of experimental chemical floods in Berea cores.

39230 Low interfacial tensions involving mixtures of surfactants. Wade, W.H.; Schechter, R.S.; Morgan, J.C.; Jacobson, J.K. New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—180).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

The interfacial tension of surfactant mixtures with hydrocarbons obeys a simple scaling rule. Many apparently inert surfactants give low tensions when in mixtures, and the scaling rule still applies to these mixtures. The influence of surfactant structure and molecular weight on low tension behavior is examined, and the application of these results to the optimization of surfactant flooding systems is discussed.

39231 Effect of system wettability on oil displacement by micellar flooding. Kremesec, V.J.; Treiber, L.E. New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers (1976). 16p. (CONF-761008—181).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

The recovery of waterflood residual oil in laboratory oil- and water-wet porous media by a micellar fluid is studied both experimentally and theoretically. The theory shows that the oil displacement performance of micellar fluids in oil- and water-wet cores is governed by the relative permeability curves, the residual oil saturation, and the effectiveness and the relative rate of advance of the micellar displacement front. Excellent agreement has been found between experiment and theory. The effectiveness of the displacement front is dependent upon the following criteria: (1) satisfying the mobility control requirements, and (2) attaining the required interfacial tension reduction. Mobility control requirements are such, in the tests conducted here, that higher apparent viscosities of the micellar fluid are required for effective displacement in oil-wet than in water-wet cores. The required reduction in interfacial tension is not known for oil-wet systems, but apparently an interfacial tension reduction of the order of 10^4 is sufficient to displace continuous oil or large ganglia. The relative rate of advance of the displacement front is determined by surfactant loss and the saturation of the bypassed fluids. Surfactant loss is shown to slow down the relative rate of advance of the displacement front, which in turn delays the start of tertiary oil production and reduces the size of the oil cuts. The saturation of fluids bypassed by the displacement front is dependent upon the miscibility of the micellar fluid with the reservoir brine and is dependent upon the effectiveness of oil displacement.

39232 Theory and practice of the closed-chamber drill-stem test method. Alexander, L.G. New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—58).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

The closed-chamber technique for drill stem testing of wells offers a high degree of safety and allows on-site optimization of the measurements during the flowing and buildup periods. It provides a complete record of flow rates and pressures. And no flow, however small, is too small to be measured with this procedure. When the closed-chamber method is used, the chances of meeting the objectives of the drill-stem test are greatly improved.

39233 Casing strain resulting from thawing of Prudhoe Bay permafrost. Ruedrich, R.A.; Perkins, T.K.; Rochon, J.A.; Christman, S.A. New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers (1976). 16p. (CONF-761008—68).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

The production of hot fluids through thick permafrost at Prudhoe Bay will result in some thawing and consolidation (compaction) of permafrost soils. Within the last several years, a considerable effort has been expended to study the influence of permafrost thawing and consolidation on casing design. These studies included a large-scale field test as well as laboratory investigations of the mechanical properties of frozen and thawed permafrost soils, numerical simulations of the consolidation process, and experimental and mathematical studies of casing strain limits. This paper describes, in some detail, the Prudhoe Bay large-scale field test and laboratory studies of mechanical properties of various permafrost soils. Four classes of lithology—sand, silty sand, sandy silt, and silt—were utilized in the laboratory studies. The soils were collected from shallow borings and from outcrops in the Prudhoe Bay region. The most significant property measured was the compaction coefficient. The modulus of axial deformation and the ratio of vertical stress change to horizontal stress change were determined under a condition of increasing mean stress (compaction). Shear stress data for these lithologies also were developed. These data and the field test results were employed as input data to various numerical simulations of the consolidation process to develop an acceptable producing well casing design for the Prudhoe Bay Field.

39234 Method of using cementing composition having improved flow properties. Adams, S.L.; Martin, F.D.; Cook, M.M. (to Calgon Corp.). US Patent 4,011,909. 15 Mar 1977. Filed date 29 Jan 1976. 12p.

Methods of using aqueous hydraulic cement compositions containing polyamido-sulfonic compounds as flow-property-improving and turbulence-inducing additives are disclosed. 10 claims.

39235 Polymer flooding in high permeability reservoirs. Rhudy, J.S.; Gogarty, W.B.; Knight, B.L.; Fullinwider, J.H. (to Marathon Oil Co.). US Patent 4,011,910. 15 Mar 1977. Filed date 13 Jun 1973. 4p.

Mobility control is improved in secondary-type oil recovery through injection of two aqueous polymer solutions. The polymer of the first solution has an average molecular weight of at least 10 million and the polymers effect a substantial reduction of permeability of the reservoir flooded. The second solution contains a polymer which does not substantially change rock permeability, but imparts a viscosity increase to the solution. An example of the polymer used in the first solution is a high molecular weight polyacrylamide and in the second solution is a biopolymer such as a polysaccharide. 1 claim, 2 figures.

39236 Hydrofracture in Weber sandstone at high confining pressure and differential stress. Lockner, D.; Byerlee, J.D. (U. S. Geological Survey, Menlo Park, California 94205). *J. Geophys. Res.;* **82**: No. 14, 2018-2026(10 May 1977).

Acoustic emission monitored during the hydraulic fracturing of two intact samples of Weber sandstone was used to determine the location and orientation of macroscopic fracture planes caused by the fracturing process. The locations of microfractures that were determined from the acoustic emission data corresponded closely with observed fractures. Pore fluid was injected into the two samples at different rates (3.3×10^5 cc/s and 3.3×10^4 cc/s) until failure occurred. The sample injected at the slower rate failed in shear, whereas the sample injected at the faster rate failed in tension. Both samples were subjected to 1000-bars confining pressure and 4000-bars differential stress. To further study how tension and shear failure depend on pore fluid injection rate and differential stress, a series of 16 hydraulic fracture experiments were run on smaller 2.54-cm-diameter samples without monitoring acoustic emission. It was found that over a wide range of stresses, either shear or tension failure could be produced simply by varying the rate at which fluid was injected into the sample. A theoretical model was developed to calculate the pore pressure distribution in the samples as a function of time, borechole pressure, and differential stress. The model was used to relate the failure mechanism (tension or shear failure) to the pore pressure distribution in each sample by analysis that required knowledge of the porosity and permeability of Weber sandstone. To supply the input data necessary for the numerical model, a series of permeability measurements were conducted. These measurements show that permeability is dependent upon effective pressure and differential stress. The principal goals of these experiments were to determine whether acoustic emission could be used to locate hydraulic fractures and to study the factors which control hydraulic fracture initiation, either in tension of in shear.

PROCESSING

REFER ALSO TO CITATION(S) 39378

39237 (BERC/RI—76/17(Vol.1)) Overview and review of motor gasoline desulfurization. Volume 1. (Bonner and Moore Associates, Inc., Houston, Tex. (USA)). Dec 1976. Contract EY-76-C-02-0041. 80p. P 05/MF A01.

The general technology for desulfurizing motor gasoline is described and prior studies reviewed. The removal of additional sulfur from motor gasoline may be required because catalytic converters on 1975 and later model cars may convert the sulfur into potentially environmentally undesirable compounds, sulfuric acid mist and sulfate particles, when the exhaust passes through the catalytic converter. While other methods of solving this environmental issue are available, only the removal of additional sulfur from

gasoline is considered in this study. In perspective, today's motor gasoline desulfurization question deals with removal of remaining sulfur from gasoline; the initial sulfur has already been removed. The various methods by which refiners could lower the sulfur level of finished motor gasoline are discussed. The relationship of these methods to sulfur levels of other products and the relationship of methods of control of sulfur levels of non-gasoline products to that of gasoline are considered. Five previous studies, which are summarized, developed total industry costs for desulfurizing motor gasoline. Four studies concluded that 100 wppM of sulfur should be the lowest average level of unleaded gasoline that refiners should be expected to produce. Four of the studies reported costs at 30 or 50 wppM, with the comment that this was impractical or extremely expensive relative to alternate methods of reducing automobile sulfate emissions.

39238 (BERC/RI—76/17(Vol.2)) **Motor gasoline desulfurization study. Volume 2.** (Bonner and Moore Associates, Inc., Houston, Tex. (USA)). Dec 1976. Contract EY-76-C-02-0041. 164p. P 08/MF A01.

The U.S. refining industry cost for desulfurizing unleaded gasoline to an average of 100 weight parts per million (wppM) sulfur in 1980 is estimated at 0.23 cents per gallon of gasoline based on increased operating and capital cost for a 420 million dollar investment. Approximate cost for 1985, when nearly all of the gasoline produced is forecast to be unleaded, is approximately 0.37 cents per gallon at 100 wppM average sulfur level and requires a 900 million dollar investment. These costs and investments are in 1976 dollars. As a point of reference, these expenditures represent 24 percent and 51 percent of the total estimated 1976 refining expenditures, and 17 percent and 36 percent of the annual construction industry's ability to manufacture and install this type of equipment. The 1980 desulfurization cost indicates that the U.S. refining industry can meet a new low-sulfur specification over the short term, if necessary, at a high but reasonable cost--while automobile manufacturers attempt to balance engine fuel economy for national energy policy with emission limits for environmental protection needs or determine that auto sulfate emission will not present a health hazard. The approximate 1985 desulfurization cost is significant in that it emphasizes the high cost associated with desulfurizing gasoline if the catalytic converter sulfate emissions are proven to be hazardous.The increase in cost between 1980 and 1985 reflects the necessity for removing sulfur from the entire gasoline pool by 1985; when almost the entire motor gasoline pool is unleaded, sulfur must be removed (not merely shifted). Desulfurization costs reported herein are lower than those reported in most of the prior studies.

39239 **Study of Umm Baraka crude oil for jet fuel production.** Abour-Gheit, A.K.; Farag, F.M.; Youssef, M.H.; Khalil, F.H.; Abdou, I.K. pp 157-163 of In Current research in petroleum fuels. I. New York; MSS Information Corporation (1976).

Kerosene fractions have been prepared by fractional distillation of Umm Baraka crude oil, such that they possess successive ten degree end point increments. A study of the jet fuel properties of these fractions has proved that the fraction b.r. 140 to 220°C meets all specifications required by a widely used U.A.R. military jet fuel. A fraction with a wider boiling range (130 to 240°C) can also meet these fuel specifications after a simple urea treatment (24.5 percent of the crude).

39240 **Role of paraffin wax in the formation of minor products in the catalytic cracking of petroleum distillates over La—Y.** John, T.M.; Wojciechowski, B.W. (Queen's Univ., Kingston, Ont.). *Can. J. Chem. Eng.;* **54**: No. 6, 584-589(Dec 1976).

An investigation of the role of paraffin wax in the catalytic cracking of wax-bearing petroleum distillates has been carried out in a fixed-bed reactor containing La-Y catalyst over a temperature range from 482 to 524°C. By using the concept of initial product selectivity derived from the time-on-stream theory of catalyst decay, it was found that increasing the wax content of the feedstocks resulted in an increase in the yield of C_4^+ gasoline and a decrease in the yields of most of the gaseous products and of coke. Ethane and propylene and the olefin content of the gasoline increased in yield with the addition of wax. The mixing of cracking feedstocks has only a linear effect on the reactivity and no synergistic effects in any of the observed properties of the reaction are in fact observed.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 39692, 39695, 39696, 39697

39241 (PB—255608) **Mandatory oil import program. Draft environmental impact statement.** (Federal Energy Administration, Washington, D.C. (USA). Office of Energy Conservation and Environment). Jun 1975. 337p. (FEA/D—75/303). NTIS $10.00.

This report considers the environmental impact of, and alternatives to, regulations implementing Presidential Proclamation No. 3279, as recently amended by Proclamation Nos. 4210, 4341 and 4355, including amendments to FEA's Mandatory Oil Import Regulations, 10 C.F.R., Parts 206 and 213, and the Mandatory Petroleum Allocation and Price Program, 10 C.F.R., Parts 211 and 212. These regulations establish and distribute the burden of increased fees on imports of crude oil and petroleum products. It has been prepared for the purpose of describing and analyzing the environmental, social and economic impacts that would result from the oil import fee schedule established by those regulations. (GRA)

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 39251, 39389, 40189

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 40251

39242 (PB—258766) **A four-year analysis of vegetation following an oil spill in a freshwater marsh. Completion report.** Burk, C.J. (Massachusetts Univ., Amherst (USA). Water Resources Research Center; Smith Coll., Northampton, Mass. (USA). Dept. of Biological Sciences). Jun 1976. Contract DI-14-31-0001-5021. 46p. (Pub—71). Q 03/MF A01.

Prepared by Smith Coll., Northampton, Mass. Dept. of Biological Sciences.

Changes in the composition of vegetation occurring in a freshwater marsh were studied for four years following an accidental oil spillage. Total plant cover and diversity measured by species richness, mean species per quadrat, and the Shannon-Wiener function were progressively reduced in both high and mid-marsh zones for two years after the spillage. Eighteen of the species found before the spill were not found the season following. Perennial species tended to be less affected by the oil immediately following the spill than annual species. (GRA)

39243 (USGS-OFR—76-451) **Oilspill risk analysis for the Mid-Atlantic Outer Continental Shelf lease area.** (Geological Survey, Reston, Va. (USA)). 1976. 26p. TIC.

An oil spill risk analysis was conducted to determine relative environmental impacts of developing oil in different regions of the Mid-Atlantic Outer Continental Shelf lease area. The study analyzed probability of spills, likely path of pollutants from spills, and locations in space and time of recreational and biological resources likely to be vulnerable. These results are combined to yield estimates of the overall oilspill risk associated with development of the lease area.

39244 (USGS-OFR—76-653) **Oilspill risk analysis for the South Atlantic Outer Continental Shelf lease area.** (Geological Survey, Reston, Va. (USA)). 1976. 57p. TIC.

An oil spill risk analysis was conducted to determine relative environmental hazards of developing oil in different regions of the South Atlantic Outer Continental Shelf lease area. The study analyzed probability of spill occurrence, likely path of pollutants from spills, and locations in space and time of recreational and biological resources likely to be vulnerable, paying particular attention to "worst-case" conditions. These results are combined to yield estimates of the overall oilspill risk associated with development of the lease area.

39245 **Toxicity of No. 2 fuel oil to coon stripe shrimp.** Vanderhorst, J.R.; Gibson, C.I.; Moore, L.J. (Battelle Pacific Northwest Labs., Sequim, WA). *Mar. Pollut. Bull.;* **7**: No. 6, 106-108(Jun 1976).

Bioassay of a No. 2 fuel oil dispersion with shrimp in a continuous flow system using measured waterborne oil as the indicator of oil concentrations reveals a treatment more definable than those previously described in terms of volume ratios and produces lower lethal concentrations. Shrimp 96-h LC_{50} was 0.8 mg/l in this study as compared to values from 1.5 to 50 mg/l reported for other methods. Mean concentrations in tests do not give significant differences in concentration with respect to day of the test or spatial distribution in the exposure tanks.

39246 (PB—255956) **Temperature effects of crude oil in the upper intertidal zone. Final report.** Straughan, D. (University of Southern California, Los Angeles (USA). Allan Hancock Foundation). Jul 1976. 64p. NTIS $4.50.

Experiments were conducted in the field and laboratory in Southern California to determine the effects of heavy black asphaltic Santa Barbara crude oil on the intertidal barnacle Chthamalus fissus. Observations were also made on surfaces in the Santa Barbara Channel oiled following the 1969 Santa Barbara oil spill. The data presented support the original hypothesis that this type of oil acts as a black body. It is this 'black body' effect which has a long term influence on Chthamalus fissus distribution after the oil has developed a hard surface crust. (GRA)

39247 Direct and indirect effects of oil ringed seals (Phoca hispida) of the Beaufort Sea. Geraci, J.R. (Univ. of Guelph, Ont.); Smith, T.G. *J. Fish. Res. Board Can.;* **33**: No. 9, 1976-1984(Sep 1976).

Ninety-six ringed seals (Phoca hispida) were taken from nets at Brown's Harbour, Northwest Territories, in the fall of 1974. Comparison with two other net samples from 1971 and 1972 revealed a lower proportion of young-of-the-year and a lower mean weight of seals in all age-classes. Six seals immersed in Norman Wells crude oil for 24 hr at the field netting site suffered only transient eye problems and minor kidney and possibly liver lesions; no permanent damage was observed. Three seals transported to the University of Guelph all died within 71 min after oil was introduced into their pool. Hematologic and blood chemical studies indicate that death was caused by oil superimposed on the stress of captivity. Six 3- to 4-week-old wild whitecoat harp seal (P. groenlandica) pups at the Magdalen Islands, Quebec, were coated with crude oil. No significant differences in core body temperatures were noted and no deleterious effects were observed. Five captive ringed seals at Guelph were subjected to a cumulative dosage of Norman Wells crude oil fed with their fish food. High dosage (75 ml) and low dosage (25 ml) of crude oil were also fed to two groups of six harp seal pups. No significant lesions or behavioral changes were noted. These experiments were of an acute nature and reflect the effects of a brief contact with oil only. Effects of longer contact as would probably be the case in an offshore oil well blowout situation are discussed. Possible effects of large-scale offshore oil fields are also considered.

39248 High seas oil pollution: particulate petroleum residues in the North Atlantic. Levy, E.M.; Walton, A. (Bedford Inst. of Oceanography, Dartsmouth, Nova Scotia). *J. Fish. Res. Board Can.;* **33**: No. 12, 2781-2791(Dec 1976).

The results of continuing investigation into the occurrence and distribution of particulate petroleum residues on the surface of the North Atlantic are presented. From 1971 to 1974 more than 850 samples were collected from the North Atlantic on transects between the east coast of Canada and South America, the Caribbean, Baffin Bay and surrounding waters, the Labrador Sea, and the Azores. Repeated sampling was carried out in the Gulf of St. Lawrence and the region between Nova Scotia and Bermuda. The results indicate that the waters north of the Gulf Stream-North Atlantic Current system were virtually free from floating petroleum residues, while the waters of the Gulf Stream, Sargasso Sea, and Caribbean Sea were much more heavily polluted. Although concentrations as high as 91.8 mg/m^2 were encountered, the general level of pollution was much less with tar contents in southern waters following a lognormal distribution with a geometric mean of 0.16 mg/m^2. The geographical distribution of tar is interpreted in terms of inputs from shipping and tanker traffic and surface circulation patterns.

39249 Response to crude oil contamination by Cricotopus (Cricotopus) bicinctus and C. (C.) mackenziensis (Diptera:Chironomidae) in the Fort Simpson area, Northwest Territories. Rosenberg, D.M.; Wiens, A.P.; Saether, O.A. (Freshwater Inst., Winnipeg, Manitoba). *J. Fish. Res. Board Can.;* **34**: No. 2, 254-261(Feb 1977).

Cricotopus (Cricotopus) bicinctus (Meigen) and C. (C.) mackenziensis Oliver, two common species of Chironomidae in the Fort Simpson area, N.W.T., were examined for changes resulting from experimental field exposure to Norman Wells crude oil. Larvae of both species were always present in higher numbers on oiled than unoiled artificial substrates but numbers of C. bicinctus increased more quickly than C. mackenziensis in response to the oil. Cricotopus mackenziensis larvae occurred in higher numbers than C. bicinctus larvae on unoiled artificial substrates. Cricotopus bicinctus tended to dominate C. mackenziensis on oiled artificial substrates. Size of larvae, as measured by head capsule width, was unaffected by increased food supply during periods of maximum algal biomass on oiled artificial substrates. Larvae on oiled artificial substrates apparently produced part of another generation when compared to larvae on unoiled artificial substrates.

POLICY, LEGISLATION, AND REGULATION

39250 Review of Texas Railroad Commission Rule 36 for operation in hydrogen sulfide areas. Smith, J.E. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—89).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Rule 36 issued by the Railroad Commission of Texas on March 15, 1976, effective Sept. 1, 1976, is a regulation developed to insure the safe design and operation of oil and gas activities that must handle hydrogen sulfide. The application of the rule has expanded to become an industry guideline for these types of operations. In developing the regulation it was necessary to apply certain engineering concepts. These concepts and the manner in which they were applied are reviewed. Insuring the safety of the general public is one of the highest callings of the professional engineer. Insight into the engineering criteria on which the regulation was based will assist the engineer in its effective application.

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 39162, 39168, 39690

PROPERTIES

REFER ALSO TO CITATION(S) 39691

39251 (BERC/RI—77/3) Waste lubricating oil research: a comprehensive characterization of five typical re-refinery feedstocks. Part 5. Cotton, F.O.; Whisman, M.L.; Goetzinger, J.W.; Reynolds, J.W. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Apr 1977. 23p. P 02/MF A01.

By use of procedures developed previously at this research center, five feedstock samples of used lubricating oil obtained from re-refineries were characterized in detail. A combination of silica-alumina gel and gel permeation chromatography was used to separate the oils into simpler fractions for analysis by low voltage mass spectrometry. The data show the various samples to be extremely similar, implying that an acceptable reclamation procedure should produce consistent re-refinery product with minimal effects from feedstock variations.

39252 (BERC/RI—77/4) Infrared analysis techniques for oil identification. Grizzle, P.L.; Coleman, H.J. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Apr 1977. 24p. P 02/MF A01.

Infrared (IR) absorbance data at 14 selected frequencies were obtained for 52 crude oils and 52 corresponding topped (distilled through 275°C) crude oil samples. Statistical analysis of the absorbance data justifies the use of 12 of these frequencies for the identification of weathered (topped) crude oils as well as unweathered crude oil samples. Detailed comparison of the IR absorbances at each frequency for 46 pairs of crude oils and corresponding topped crude oil samples indicates that, on the average, the magnitude of these bands will change by approximately 9 percent upon weathering and that changes as large as 21 percent can and, in general, will occur. Comparative absorbance data analysis of a group of artificially weathered and unweathered crude oil samples from a common geographical location indicates that spectrally similar unweathered crude oils can be differentiated by IR analysis. Results also suggest that unweathered reference crude oil samples should be artificially weathered by a consistently reliable weathering procedure before comparative analysis to a weathered spilled sample.

39253 Study of the structural-group composition of organo-sulfur compounds of petroleum by mass spectrometry and molecular spectroscopy. Parfenova, M.A; Brodskii, E.S.; Zimina, K.I.; Lyapina, N.K.; Nikitina, V.S.; Kakabekov, G.G.; Simeonov, A.A.; Kalamashvili, E.M. (Inst. of Chemistry, Bashkir, USSR). *Pet. Chem. (USSR) (Engl. Transl.);* **15**: No. 4, 227-234(1975).

Translated from Neftekhimiya; 15: No. 4, 902-908(1975).

A detailed structural and group investigation was made of the composition of sulphides and thiophens of distilled diesel oils of Arlan crude by methods of thermodiffusion, adduct formation, and mass spectrometry. Sulfides are distributed in the fractions by thermal diffusion mainly according to the degree of ring formation and to a lesser extent, according to the number and chain length of substituents. Sulfides with a large number of rings in the molecule are concentrated in the last fractions. The degree of substitution of thiamonocyclanes is about 3, thiabicyclanes, about 2 and the chain length of alkyl substituents in thiacyclane molecules varies between 1 and 8 carbon atoms, more than two carbon atoms being present only in one of the chains. The structural and group composition of thiophens is characterized by the presence of 60 percent alkyl-substituted and 30 percent cycloalkyl-substituted products; the average number of alkyl substituents is about three.

39254 Current research in petroleum fuels. I. New York; MSS Information Corporation (1976). 211p.

Seven papers are included in the volume. A separate abstract was prepared for each paper. (JRD)

39255 Catalytic reformer product octane measurement via total aromatics. McCoy, R.D. pp 10-23 of In Current research in petroleum fuels. I. New York; MSS Information Corporation (1976).

It has been determined that the research octane number (RON + 3 ml) of leaded reformates can be adequately calculated

from a chromatographic analysis of total aromatics. For a given feed composition, the relationship between octane of the product and its aromatic content is linear over the 90-100 octane range investigated. In addition, it has been found that both the slope, A, and intercept, B, in the linear equation octane = A (percent aromatics) + B can be determined from a single laboratory knock engine calibration measurement. A process chromatograph has been modified to include in its programmer the analog calculation of the above equation. Octane is then read out directly from a measurement of the two "components," total saturates and total aromatics, on a three-minute cycle.

39256 Isolation and determination of aromatics in gasoline by gas chromatography. Stavinoha, L.L.; Newman, F.M. pp 24-39 of In Current research in petroleum fuels. I. New York; MSS Information Corporation (1976).

The conditions under which N, N-bis(2-cyanoethyl) formamide (CEF) can be used as a liquid phase for the GC separation of aromatics from the other components of motor gasolines having final boiling points no greater than 486°F have been determined. A multiple-oven GC system employing an isothermal CEF column, appropriate valving, a liquid sampling valve and a temperature-programmed Dexsil 300 column has been used to provide analyses of the aromatic and the saturate-olefin fractions of gasolines. Highly precise volumetric analyses are made of the benzene, toluene, ethylbenzene, m + p-xylene, o-xylene, isopropylbenzene and C_9 + aromatics using a direct calibration method. Procedures are also provided for the determination of the boiling-point distribution of both the aromatic fraction and the saturate-olefin fraction of the gasolines. Provisions for extending the procedure to higher boiling-point materials are discussed.

39257 Internal standards for the isolation and determination of aromatics in motor gasoline. Stavinoha, L.L. pp 40-52 of In Current research in petroleum fuels. I. New York; MSS Information Corporation (1976).

Potential internal standards have been evaluated for use in a gas chromatographic method for isolating and determining aromatics in gasolines having final true boiling points no higher than 488°F. The precision of the previous direct calibration method relied on a high-pressure/high-temperature liquid sampling valve for precise volume repeatability. Additionally, long-term stability of the hydrogen flame ionization detector sensitivity and an accurately prepared, stable standard for direct calibration were required to ensure precision. Ethyl propionate and 2-pentanone have been shown to be suitable as internal standards. Thus, the need for the precise sample introduction and external calibration required in the previous method has been eliminated. Sample preparation, response factors, and data reduction techniques have been examined for the internal standard method of aromatics determination in gasoline. The use of ethyl propionate as an internal standard has been demonstrated in the analysis of several gasolines that have broad aromatic concentration distributions. The results of this method agreed well with those results obtained by the previous direct calibration method.

39258 Status of unleaded and low-lead gasoline composition. Interim report FLRL No. 16. Bowden, J.N. pp 53-114 of In Current research in petroleum fuels. I. New York; MSS Information Corporation (1976).

Numerous technical and statistical publications have been made on the chemical, physical, and performance properties of unleaded and low-lead gasolines. However, very little information is available on the aromatic and olefinic distribution of these fuels since the standard FIA method (ASTM D 1319) used to determine hydrocarbon composition gives only an approximation of total aromatics, olefins, and saturates. Because of the necessity to have definitive analysis of these hydrocarbon species for obvious reasons relating not only to fuel performance/emissions but also to potential fuel-handling/distribution problems, a program was conducted to provide a representative sampling of current marketplace unleaded/low-lead gasolines for subsequent analysis of their aromatic and olefinic hydrocarbon distributions. Results of the investigation are tabulated.

39259 Hydrogen content as a measure of the combustion performance of hydrocarbon fuels. Martel, C.R.; Angello, L.C. pp 116-156 of In Current research in petroleum fuels. I. New York; MSS Information Corporation (1976).

Previous work by various investigators has shown that the hydrogen content of a hydrocarbon jet fuel is the primary variable affecting the combustion performance of the fuel; i.e., the amount of heat radiated during the combustion of the fuel within the jet engine combustor. The results of statistical correlations of fuel data are presented wherein the hydrogen content of fuels is correlated with other fuel combustion measurements including smoke point, luminometer number, and net heat of combustion. Also, the hydrogen content of fuel is correlated with the specific gravity and aniline point measurements. It is concluded that the fuels' hydrogen content can be calculated with sufficient accuracy to eliminate the need for measuring smoke points, luminometer numbers, and net heat of combustion. For conventional jet fuels (JP-4, JP-5, JP-8, Jet A, Jet A-1, and Jet B) a minimum allowable hydrogen content of 13.5 percent by weight is recommended.

39260 How stable is diesel in storage. LePera, M.E.; Sonnenburg, J.G. pp 166-178 of In Current research in petroleum fuels. I. New York; MSS Information Corporation (1976).

The results of a two-year storage stability program reveal current production diesel fuels meeting the requirements of Federal Specification VV-F-800a may not provide for satisfactory storage stability under conditions of bulk fuel storage. Moreover, in view of the "relatively mild" ambient temperatures experienced at Aberdeen Proving Ground as compared with those higher temperatures experienced in locations such as Yuma Proving Ground and Panama Test Center, the rate at which these fuels may deteriorate could be considerably higher. The data show that the 2 to 2.5 mg/100 ml maximum specified for accelerated stability does not limit nor exclude the types of fuel having unsatisfactory storage stability that can be procured.

STORAGE

39261 Dubai marine terminal simulation. Woodyard, A.H.; Gorczyca, J.A.; Winton, T.L. (Continental Oil Co., Houston, TX). pp 360-365 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976). See CONF-760703—.

The marine terminal simulation model has proven to be a credible tool for evaluating various combinations of field production rates, storage, and number of tankers. The experience gained from this model was applied to marine terminals operating elsewhere, permitting some general conclusions to be reached on the key variables affecting terminal efficiency.

COMBUSTION

REFER ALSO TO CITATION(S) 39167, 39168

NATURAL GAS

REFER ALSO TO CITATION(S) 39663, 39694

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 39192, 39194, 39195, 39266

39262 (MERC/CR—77/3) **Fractographic logging for determination of pre-core and core-induced fractures: Nicholas Combs No. 7239 well, Hazard, Kentucky.** Kulander, B.R.; Dean, S.L.; Barton, C.C. (Energy Research and Development Administration, Morgantown, W.Va. (USA). Morgantown Energy Research Center). Jan 1977. Contract ME6-P-2820. 48p. P 03/MF A01.

Methods results, and conclusions formulated during a prototype fractographic logging study of seventy-five feet of oriented Devonian shale core are summarized. The core analyzed is from the Nicholas Combs No. 7239 well located twelve miles due north of Hazard, Kentucky. The seventy-five foot core length was taken from a cored section lying between 2369.0 feet (subsea) and 2708.0 feet (subsea). Total core length is 339.0 feet. The core was extracted from the upper Devonian Ohio and Olentangy shale formations. Results indicate that there are few tectonic (pre-core) fractures within the studied core section. The region may nevertheless be cut at core sample depth by well-defined vertical or inclined tectonic fractures that the vertically drilled test core didn't intersect. This is likely since surface Plateau systematic fractures in other Plateau areas are vertical to sub-vertical and seldom have a frequency of less than one major fracture per foot. The remarkable directional preference of set three fractures about strikes of N 40° E, N 10° W, N 45° W, suggests some incipient pre-core rock anisotropy or stored directional strain energy. If this situation exists, the anisotropy strike change or stored strain variance from N 40° E to N 45° W downcore remains an unanswered question. Tectonic features, indicating local and/or regional movement plans, are present on and within the tectonichorizontal fracture set one. Slickensides had a preferred orientation within several core levels, and fibrous-nonfibrous calcite serves as fracture fillings.

39263 (MERC/CR—77/5) **Subsurface stratigraphy and gas production of the Devonian shales in West Virginia.** Patchen, D.G. (West

Virginia Geological and Economic Survey, Morgantown (USA)). Mar 1977. Contract EY-76-C-05-5199. 39p. P 03/MF A01.

The subsurface Devonian shales are defined as all of the fine clastic rocks between the top of the Onondaga Limestone and the base of the Berea Sandstone. This term is used only in the western one-third of the state where the thickness of these shales ranges from 1000 to 3000 feet. The interval thickens to the east and northeast and facies changes to coarser clastics occur. In north-central West Virginia numerous sandstones and siltstones have replaced much of the shale section, particularly the so-called Brown shales. These shales are actually dark gray to black, organic-rich, generally non-silty shales that yield higher natural radioactivity readings on a gamma-ray log, and low readings on a density log. Sample descriptions, cable-tool drillers' logs, and gamma-ray and density logs are all used to subdivide the Devonian shales into 4 zones: a thick (1100 to 1200 feet) upper sandy, silty, gray, and greenish gray shale; a thinner (300 to 400 feet) zone consisting of two dark to very dark gray shales (the Brown shales of the driller) separated by a thin gray shale; a greenish gray, generally non-silty shal; and the lowermost interval that consists of very dark to black shales, often calcareous near the base. A thin limestone is often noted within the lowest black shale and is usually referred to by drillers as the Tully. Farther to the west and southwest a fifth zone, a younger Brown shale, is present near the top of the Devonian shale sequence in the approximatestratigraphic position of the Cleveland Shale of Ohio. Natural gas has been produced for nearly 50 years from relatively shallow-depth, low-volume wells completed in the Brown shales and adjacent units. Although these wells are marginally economic at current costs, prices, and completion techniques, these shales represent a very large gas resource with less than 10 percent of the calculated gas in place ever produced.

39264 In-situ determination of residual gas saturation by injection and production of brine. Bragg, J.R.; Shallenberger, L.K.; Deans, H.A. New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—116).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

A new in-situ procedure has been developed for measuring the residual gas saturation in watered-out zones of gas reservoirs. Gas-free formation brine is injected into a well penetrating the water-invaded zone to dissolve the residual gas from a region around the wellbore. The brine is then produced from the well. The volume of brine containing no dissolved gas is then determined by sampling the brine and analyzing for gas content. The original residual gas saturation can be calculated from these data. The procedure has been confirmed by computer simulation and by laboratory tests on a long glass-bead pack. Two full-scale field tests have also been conducted; the interpretation of one of these tests is discussed in detail.

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 39208, 39224, 39234, 39695

39265 Transient pressure behavior for a well with a finite conductivity vertical fracture. Heber Cinco L; Samaniego V, F.; Dominguez A, N. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—14).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

A mathematical model was developed to simulate the transient behavior of a well with a finite conductivity vertical fracture in an infinite slab reservoir. For the values of time of interest, t/sub D/ is greater than 10^{-2}, p/sub wfD/ can be correlated by a dimensionless parameter C/sub r/ = wk/sub f//πL/sub f/k, where w, k/sub f/, and L/sub f/ are the width, permeability, and half fracture length of the fracture. Results when plotted as a function of p/sub wfD/ vs log t/sub D/ give, for large t/sub D/, the 1.151 slope straight line. Thus, the semilogarithmic pressure analysis methods can be applied. Results when plotted in terms of log p/sub wfD/ vs log t/sub D/ show a set of curves of characteristic shape for the different C/sub r/ values. Therefore, a type-curve matching procedure can be used to analyze transient pressure data to obtain the formation and fracture characteristics.

39266 Evaluation of fluid pH effects on low permeability sandstones. Simon, D.E.; McDaniel, B.W.; Coon, R.M. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—20).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

The continued success of completing commercially producing wells in formations with permeabilities in the 0.5 to 0.01 millidarcy range has resulted in the need for laboratory techniques in evaluating the effects of water base stimulation fluids on the formation matrix. Use of fluid flow tests becomes nearly impossible and results are generally inconclusive when the air permeability is less than 0.5 md. Still, the need exists for evaluating the compatibility of potential aqueous stimulation fluids with formation minerals. The purpose of this paper is to report on the use of the Scanning Electron Microscope (SEM) to evaluate the effect of pH of aqueous base fluids on clay minerals associated with the pore space. Included are SEM photomicrographs showing sample areas before and after exposure to aqueous fluids with emphasis being placed at the pore openings. All work is directed toward low permeability sandstone formations. This study is concerned with the effect of pH on the relatively non-swelling clay minerals, kaolinite, chlorite, and illite, as well as the more highly water swellable clays, mixed layer and montmorillonite. By examining SEM micrographs of a small area of the core before and after exposure to fluids with different pH values, it can be seen that the formation rock samples tested are, in general, more compatible with low pH fluids than with high pH fluids.

39267 Determination of gas well deliverability of vertically fractured wells. Hadinoto, N.; Raghavan, R.; Thomas, G.W. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 16p. (CONF-761008—135).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

The applicability of commonly accepted radial flow solutions to estimate deliverability of vertically fractured gas wells was examined. Synthetic deliverability data (isochronal and flow after flow) were generated using a two-dimensional single-phase gas simulator. The effect of fracture length and pressure level and PVT data was investigated. Flow-after-flow data also were used to investigate the application of the Odeh-Jones method for analyzing variable rate drawdown data to determine formation permeability and skin factor (fracture length) for a vertically fractured gas well. It is shown in this study that conventional methods of predicting deliverability from short-time isochronal and flow-after-flow tests will lead to calculation of erroneous values of absolute open flow (AOF) than that which would be obtained from long-time flow tests. Depending on specific conditions, these errors can be either lower or higher than actual values. It is also shown that flow exponents different from unity can be obtained from short-time flow tests even though laminar flow prevails. This result is a consequence of changing flow regimes that result due to the vertical fracture. This study also indicates that if the Odeh-Jones method of analysis is used, then data obtained for analysis should correspond to the pseudo radial flow period. If early data where linear flow controls pressure behavior are used, then erroneous results will be obtained.

39268 Thorough removal of sulfur compounds from natural gas. Gel'perin, N.I.; Medvedev, E.G.; Sukhorukov, I.M.; Eremin, I.M.; Demchenko, V.A. *Sov. Chem. Ind. (Engl. Transl.);* **8**: No. 9, 718-720(Sep 1976).

Translated from Khim. Prom.; 8: No. 9, 683-684(1976).

A brief review of the literature on the removal of sulfur compounds from natural gas is presented. Preliminary removal of sulfur compounds from the gas using the low-temperature absorbent GIAP-10-2 and spent nickel-chromium catalyst is recommended to facilitate the removal of methane homologs and oxygen-containing compounds. The results of experiments on this method under industrial conditions are presented. The optimal operating conditions for the removal of hydrogen sulfide and ethyl mercaptan from natural gas using GIAP-10-2 absorbent in the presence of hydrogen and without it, and conditions for the removal of heavy sulfur compounds in the presence of spent nickel-chromium catalyst are presented.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 39692, 39695, 39697

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 40161

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

REFER ALSO TO CITATION(S) 39236

39269 (MERC/TPR—77/2) Large scale foam fracturing in the Devonian shale: a field demonstration in West Virginia. Frohne, K.H. (Energy Research and Development Administration, Morgantown,

W.Va. (USA). Morgantown Energy Research Center). Apr 1977. 17p. P 02/MF A01.

A large-scale foam fracturing operation performed on a Devonian Shale well in Jackson County, W. Va. is described. Here the Energy Research and Development Administration (ERDA) in cooperation with Consolidated Gas Supply Corp. (CGSC) conducted a foam frac using 973 bbl. water, 2160 Mscf nitrogen, and 155,000 lbs sand proppant. The gross perforated formation interval is 3238 to 3629 ft. in W. L. Pinnel No. 12041 near Cottageville, Jackson County. The frac test was conducted to help evaluate the effectiveness of foam fracturing in the low-pressure water-sensitive Devonian Shale of the Appalachian Basin. The report details the frac job and the well clean-up period with field problems encountered. Also described is the post-frac logging program run to define created vertical fracture extent and gas influx into the well bore. A post-frac deliverability test performed on the well is described. The well was found to have an absolute open flow potential of 173 Mscfd. An 804 hour pressure buildup test run on the well after the flow test indicated a static reservoir pressure of 564 psia, a well capacity of 3.42 md-ft, and an induced fracture half-length of 1155 ft.

39270 Accelerated blowdown of a strong water drive gas reservoir. Lutes, J.L.; Chiang, C.P.; Brady, M.M.; Rossen, R.H. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—171).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Final blowdown of a Gulf Coast water-drive gas reservoir at a reserves/production ratio (R/P) of less than 2 provided an increase in gas recovery of some 28 Bcf or about 30 percent over blowdown at a R/P of 15. However, pressure-production performance did not conform to conventional tank-type material balance predictions due to the presence of a large pressure gradient in the water invaded region. The material balance equation was altered to account for the pressure behind the front and was adapted to an economic optimizer program.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 39250, 39698, 39699

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 39690, 40079

39271 Repair of buried submarine pipelines in the Long Beach Unit. Ellison, W.F.; Robuck, R.D. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 8p. (CONF-761008—28).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

This report covers the planning, acquisition of equipment and materials, and organizational staffing employed by THUMS Long Beach Co. to accomplish in-place repairs of buried submarine pipelines. This paper includes a description of (1) methods and procedures developed to satisfy demands of the work environment, and (2) those actions taken for the protection and preservation of the marine environment.

39272 Optimal design of gas transmission networks. Bickel, T.C.; Himmelblau, D.M.; Edgar, T.F. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—107).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

In this work the optimal design of a gas transmission network is treated, where the optimal sizes for the pipeline segments and compressors as well as the optimal operating conditions are simultaneously determined. No one has reported in the literature the rigorous solution of such an open-ended problem, although sub-problems have been solved in which the operating conditions have been determined for a given configuration. The problem solved was to determine the optimal (1) number of compressor stations, (2) diameter and length of pipeline segments, and (3) operating conditions for each compressor station such that (a) the capital and operating costs were minimized, or (b) profit maximized. Two techniques were used. One was the Generalized Reduced Gradient Method, a nonlinear programming algorithm that could be employed directly in instances in which the capital costs of the compressor were linear with horsepower. However, for the cases in which the capital costs were comprised of an initial fixed cost plus a linear function of horsepower, it was necessary to use a branch and bound scheme combined with nonlinear programming.

39273 Application of a single-phase simulator to study the effects of liquids on pipeline efficiencies in a natural gas gathering network. Knobloch, M.H.; Brill, J.P.; Crafton, J.W. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—108).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

It is possible to history-match an existing gas pipeline network to obtain flow efficiencies that account for abnormal pressure losses resulting from liquids entrained in the gaseous flow stream. An actual gas gathering network which was known to produce relatively large volumes of condensate was successfully history-matched. The network was studied with a simulator which uses the single-phase Panhandle Equations to calculate the pressure losses in the pipeline. The observed pressures were matched in the calculations by lowering the pipeline efficiencies to account for liquids in the flow stream. Data were gathered which supported the theory that the low pipeline efficiencies resulting from the calculations were in fact due to liquids in the pipeline. Summaries and graphs of the data and calculated results are presented.

39274 Critical evaluation of friction pressure drop prediction methods for gas—liquid flow in horizontal pipes. Mandhane, J.M.; Gregory, G.A.; Aziz, K. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 16p. (CONF-761008—109).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

A large amount of available data for friction pressure gradients in two phase flow is used in this study to compare and evaluate sixteen different correlations and models. A two-step (three-step, if holdup information is required) scheme is proposed for predicting pressure gradient due to friction. An expected flow pattern is first predicted on the basis of known system variables, and the correlation recommended for use with that flow regime is then employed to predict the holdup (if required) and subsequently the pressure losses due to fluid friction. This procedure is demonstrated to yield a higher overall prediction accuracy than any of the individual methods examined.

39275 Method of transporting natural gas. Etter, B.E. US Patent 4,010,622. 8 Mar 1977. Filed date 18 Jun 1975. 8p.

A means for transporting natural gas which eliminates the need for ultra low temperature refrigeration units is claimed. The method comprises saturating natural gas at its source with certain hydrocarbon additives which liquefy at substantially higher temperatures than natural gas alone, liquefying the saturated mixture for fuel transport, transporting the mixture to its destination for usage, and adding sufficient air to the mixture prior to combustion to provide a fuel of a normal Btu capacity. 8 claims.

PROPERTIES

REFER ALSO TO CITATION(S) 39691

COMBUSTION

REFER ALSO TO CITATION(S) 39842

39276 (ORNL-tr—4322) **Use of natural gas for preparation of Na_2S using an enlarged pilot plant.** Burdin, V.V.; Chichkov, V.V.; Shurigin, A.P. Translated by L. Kobylenski from *Tr. Mosk. Energ. Inst.*; No. 125, 118-123(1972). 5p. P 02/MF A01.

Optimal conditions for reduction of a sodium sulfate melt by natural gas conversion products are summarized. The reduction is carried out in thin sulfate melt layers at 1100 to 1150°C. The reducing gas contains the highest possible concentrations of H_2 and CO. A diagram of a pilot plant used to test the process is included along with tabulated operational data. (JRD)

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 39663

SITE GEOLOGY

REFER ALSO TO CITATION(S) 39263

DRILLING, FRACTURING, AND MINING

REFER ALSO TO CITATION(S) 39269, 39280

OIL PRODUCTION, RECOVERY, AND REFINING

IN SITU METHODS, TRUE AND MODIFIED

39277 (SAND—77-0196) **Oil shale programs. Fourth quarterly report, October 1976—December 1976.** Stevens, A.L. (ed.). (Sandia Labs., Albuquerque, N.Mex. (USA)). Feb 1977. Contract EY-76-C-04-0789. 71p. P 04/MF A01.

Three programs funded by the Oil, Gas and Shale Technology Division of US ERDA are reported: (1) Diagnostics and Rock Mechanics Support for the Laramie Energy Research Center (LERC) In Situ Oil Shale Program, (2) Advanced instrumentation and field projects for in situ oil shale processing, and (3) In situ oil shale bed preparation study. Each of these programs is treated individually. Scope and plans necessary to meet the objectives are briefly stated. Activities on each program over the past quarter are discussed. (DLC)

39278 **Preliminary evaluation of Rock Springs Site 9 in-situ oil shale retorting experiment.** Wise, R.L.; Suddath, B.C.; Winter, J.M.; Jackson, L.P.; Long, A. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—8).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Successful startup of an in situ retorting experiment in the Tipton Member of the Green River oil shale formation near Rock Springs, Wy., began on April 5, 1976, at Rock Springs site 9. The target shale was located in a 40-ft zone between 137 and 177 feet beneath the surface and averaged 21.3 gallons of oil per ton and 2.3 percent water by Fischer assay. The oil shale was retorted in advance of the combustion front which propagated radially toward eight surrounding production wells. About 700 gallons of oil and 165 MM Btu of low-Btu gas were recovered during the first 35½ days of operation. Preliminary evaluation indicates that only a fraction of the oil shale reserves were retorted in advance of the combustion front. Post-retorting core samples will be evaluated after the experiment is finished. At the time this paper was prepared, the experiment was still continuing and data from only the first 35½ days of operation were available. When the experiment is completed, data from environmental monitoring of the experiment will also be evaluated to determine the impact of in situ oil shale processing on air, water, and land quality.

39279 **Oil yield and quality from simulated in-situ retorting of Green River oil shale.** Needham, R.B.; Judzis, A. Jr.; Cornelius, A.J. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—19).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

The yield and quality of shale oil produced for in-situ retorting conditions was measured by laboratory experiments and related to shale particle size, retorting temperature, and heating rate. In-situ retorting with recycle shale gas at a temperature of 800°F should result in an oil yield of 80 to 85 weight percent of Fischer assay. The in-situ retorted oil would contain 1.7 to 2.0 weight percent nitrogen and 0.5 to 0.7 weight percent sulfur; these values are typical of shale oil from the conventional gas combustion retort. The in-situ retorted oil will have a slightly higher API gravity and be more volatile than oil produced by the gas combustion retort because of additional thermal cracking during production from the larger particles. The oil yield and nitrogen content of the oil did not depend upon the shale particle size for retorting temperatures up to about 800°F, but at higher retorting temperatures, the oil yield was markedly lower for the larger particles. Therefore, in-situ retorting temperatures should be less than about 800°F.

39280 **Fracturing oil shale for in situ retorting experiments.** Carpenter, H.C. (Laramie Energy Research Center, WY). *AIChE Symp. Ser.;* **72**: No. 155, 1-13(1976).

Because oil shale is a rock with little or no permeability, it must be fractured or broken to allow the passage of fluids needed for retorting by in situ methods. The Laramie Energy Research Center has investigated a number of fracturing techniques. The first technique to be tested in the field was electrolinking, or electrocarbonization, accomplished by passing high voltage electricity through the oil shale. In the field under overburden pressure, the shale was carbonized by the electricity and small increases in permeability were noted, but no open fractures were obtained. Hydraulic fracturing has also been tested and in many cases results in increasing permeability, but retorting through hydraulic fractures would be extremely difficult because of the low surface area that results from the fracturing. To increase the surface area a number of different explosives and explosive fracturing techniques have also been investigated. Desensitized nitroglycerin displaced into a naturally occurring porous zone and into a sand-propped hydraulic fracture was used in one experiment. In another experiment slurried explosives were detonated in sand-propped horizontal hydraulic fractures. In this experiment, which is still in progress, preliminary evaluation shows the presence of both vertical and horizontal cracks intersecting the wellbores.

PROPERTIES AND COMPOSITION

REFER ALSO TO CITATION(S) 39279, 39282

39281 **Combustion of oil-shale carbon residue.** Dockter, L. (Laramie Energy Research Center, WY). *AIChE Symp. Ser.;* **72**: No. 155, 24-31(1976).

Oil-shale core samples were used to investigate the oxidation rate of the residual carbon remaining in retorted shale. Results indicate very little effect on the rate from temperature or air-sweeping rate. The oxidation rate is linearly proportional to the square root of the oxidation time and increases linearly with sample Fischer assay.

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 39078

39282 (COO—4017-1) **Trace elements in oil shale. Progress report, June 1, 1976—May 31, 1977.** (Colorado Univ., Boulder (USA)). Feb 1977. Contract EY-76-S-02-4017. 97p. P 05/MF A01.

A substantial number of samples of water, stream sediment, soils, plants, oil shale, spent shale, shale oil and other materials were collected for analyses. A considerable amount of effort was also involved in the development and validation of methods for preparing and analyzing these samples for trace element content. Among the results are: Cu, Li, and Zn exhibit well-defined trends in soils over the Piceance Basin, with values increasing from north to south; As, Mo, B, and Se are all elevated in the soils of the Piceance Basin; Mo and B are more soluble in TOSCO spent shale than in unprocessed shale and are also elevated in plants growing on spent shale; F is less soluble in spent (TOSCO) shale than in unprocessed oil shale, but although the levels in leachates are quite significant (25 mg/l). F is not readily leached out; and As and Se are not very soluble in spent shale (TOSCO) and are not taken up to a significant extent by plants.

FISSION FUELS

REFER ALSO TO CITATION(S) 39663

RESERVES

39283 (DPST—76-416) **Field manual for ground water reconnaissance. Savannah River Laboratory National Uranium Resource Evaluation Program.** Ferguson, R.B.; Price, V.; Baucom, E.I. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Jan 1977. Contract E(07-2)-1. 72p. (GJBX—26(77)). P 04/MF A01.

A manual is presented that is intended to direct and coordinate field operations, site selection, groundwater sample collection, and information codes for the Savannah River Laboratory (SRL) contribution to the National Uranium Resource Evaluation (NURE) program. The manual provides public relations information for field sampling teams as well as technical direction.

39284 **World's uranium ores, resources and production on the background of nuclear energy development.** Konstantynowicz, E. *Przegl. Gorn.;* **32**: No. 5, 225-229(1976). (In Polish).

The geochemical environment of uranium is presented. Genetic types of uranium ore deposits are determined and characterized. Attention is drawn to the commercial importance of sedimentray and metamorphic deposits. World's uranium resources, its production and demand are presented.

EXPLORATION

39285 (DPST—76-358) **Field manual for stream sediment reconnaissance. Savannah River Laboratory National Uranium Resource Evaluation Program.** Ferguson, R.B.; Price, V.; Baucom, E.I. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Jul 1976. Contract E(07-2)-1. 58p. (GJBX—30(77)). P 04/MF A01.

A manual is presented that is intended to direct and coordinate field operations, site selection, stream sediment sample collection, water sample collection, and information codes for the Savannah River Laboratory (SRL) contribution to the National Uranium Resource Evaluation (NURE) program. The manual provides public relations information for field sampling teams as well as technical direction.

39286 (GJBX—20(77)) **Hydrogeochemical and stream sediment reconnaissance of the National Uranium Resource Evaluation Program. Progress report, October—December 1976.** Aamodt, P.L.; Hansel, J.M. Jr.; Minor, M.M.; Beckman, R.J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-ENG-36. 27p. (LA—6708-PR). Dep. NTIS $4.00.

Field sampling in New Mexico was limited this quarter to the collection of water and/or sediment samples from 4000 locations in two 20,000-km^2 areas in the southeastern corner of the state. Approximately 1100 locations were sampled in Montana and Colorado as parts of pilot studies in those states, and 100 locations were sampled by a commercial contractor in south-central Wyoming. Several thousand samples were inventoried and sent to the analytical laboratories for analysis. A major effort has gone into the preparation of reports for open filing next quarter. These include reports on pilot and orientation studies, reconnaissance sampling, and topical subjects. Uranium analysis of waters by fluorometry continued at an average rate of 850 analyses per week throughout the quarter. Multielement analysis capability using x-ray fluorescence and spectrochemical methods continued to be improved to increase both sample throughput and analytical precision. Modifications to the reactor transport system have lowered the effective uranium detection limit for 40-ml water samples to 0.25 ppB. The pneumatic transfer system has also been expanded to allow rapid multielement analyses of sediment samples. Not all of the detectors have been installed to complete this system, but they will be in the next few months. Sediment samples have been analyzed for uranium at an average rate of 1000 per week during this quarter. Several new computer programs have been developed to improve both the management and statistical treatment of NURE-HSSR data.

39287 (GJBX—21(77)) **Uranium hydrogeochemical and stream sediment pilot survey of the Estancia Valley, Bernalillo, Santa Fe, San Miguel, and Torrance Counties, New Mexico.** Olsen, C.E. (Los Alamos Scientific Lab., N.Mex. (USA)). Jan 1977. Contract W-7405-ENG-36. 126p. (LA—6650-MS). P 07/MF A01.

As part of the LASL portion of the US ERDA NURE program, water samples from 534 locations and sediment samples from 2936 locations were taken over a 7770-km^2 area of the Estancia Valley in 1975 and analyzed for uranium. Uranium concentrations in the valley waters range from undetectable (<0.1) ppB to a high of 334 ppB. Statistical analysis of the water data shows that the uranium content of the water definitely depends in part on the source type and, apart from playa waters, ranges in average value from 1.78 ppB for water from artificial ponds to 5.23 ppB for well water. The highest value of uranium in water is found in a playa sample. High values of uranium in water also occur associated with high uranium values in sediment. Screen analysis of 100 selected sediment samples indicates that the -100 mesh fraction, used ultimately as a standard throughout the survey, is a good choice for the determination of uranium in sediments. The uranium content of the sediment samples varies from a minimum of 0.7 ppM to a maximum of 10.7 ppM. Statistical analyses of the data from all five of the different types of sediment source that were sampled show that the average uranium concentration is essentially independent of the source type in this area.These five sediment source types are wet streams, springs and ponds, and dry streams and ponds. Using all the sediment data, a sharply peaked distribution is obtained with an average uranium concentration of 2.92 ppM and a standard deviation of 0.73 ppM. Using a criterion of three standard deviations above the mean for the anomaly threshold level, 55 of the 2936 locations sampled for sediment have anomalous uranium concentrations. Generally, these locations occur in areas having known radiometric highs or in formations found to be uraniferous in other areas. This report provides listings of all the basic data utilized and plots of numbered sample locations at 1:125,000 scale. It also includes a geologic map of the area.

39288 (LA—6730-MS) **Uranium concentrations in lake and stream waters and sediments from selected sites in the Susitna River Basin, Alaska.** Hill, D.E. (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1977. Contract W-7405-ENG-36. 50p. (GJBX—31). P 03/MF A01.

During the summer of 1976, 141 water and 211 sediment samples were taken from 147 locations in the Susitna River basin in Alaska by the Geophysical Institute of the University of Alaska for the LASL. These samples were taken to provide preliminary information on the uranium concentrations in waters and sediments from the Susitna River basin and to test the analytical methods proposed for the NURE Hydrogeochemical and Stream Sediment Reconnaissance for uranium in Alaska. The uranium determinations resulting from the fluorometric analysis of the water samples and the delayed-neutron counting of the sediment samples are presented. The low levels of uranium in the water samples, many of which were below the detectable limit of the LASL fluorometric technique, indicate that a more sensitive analytical method is needed for the analysis of Alaskan water samples from this area. An overlay showing numbered sample locations and overlays graphically portraying the concentrations of uranium in the water and sediment samples, all at 1:250,000 scale for use with existing USGS topographic sheets, are also provided as plates.

39289 (UCID—16911-76-2) **Hydrogeochemical and stream-sediment survey of the National Uranium Resource Evaluation (NURE) program: western United States. Quarterly progress report, April—June 1976.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1976. Contract W-7405-ENG-48. 76p. (GJBX—59(76)). P 05/MF A01.

Activities of the Hydrogeochemical and Stream Sediment Survey being conducted by the Lawrence Livermore Laboratory (LLL) in support of the National Uranium Resource Evaluation (NURE) Program are summarized. During the period the Walker River Basin pilot study preliminary data report was completed. Smoke Creek Desert, Cave Valley, and the Roach Lake Basin were revisited to obtain water, sediment, and rock samples. These samples, along with samples from the Winnemucca Dry Lake Basin, are being analyzed. Geochemical studies were initiated to: (a) determine the best sieved size fraction to detect uranium anomalies, (b) normalize seasonal variations in the uranium content of streams, and (c) develop the methodology for using multielement analysis to define the geological and/or geochemical setting in which the sample was derived. Sampling sites were selected for the Humboldt River Basin and request for quotations (RFQs) for sampling were sent to potential contractors. Sampling site selection has been initiated for the region covered by the Lovelock Army Map Service (AMS) quadrangle. The clean-room facility to house rabbit preparation, water-sample analysis, and the emission spectrometer has been designed; construction should be completed by December 15, 1976. Installation of the high-throughput instrumental neutron-activation analysis (INAA) system should be completed in November 1976. This system will enable the multielement analysis of some 20,000 sample sites per year.

39290 (USGS-OFR—75-595) **Abstracts of the 1975 uranium and thorium research and resources conference.** Craig, L.C.; Brooks, R.A.; Patton, P.C. (eds.). (Geological Survey, Reston, Va. (USA)). 1975. 55p. (CONF-751251—(Absts.)). TIC.

From Uranium and thorium research and resources conference; Golden, Colorado, United States of America (USA) (8 Dec 1975).

Abstracts for the technical papers given at the 1975 Uranium and Thorium Research and Resources Conference are compiled. Some of the material presented at the meeting was preliminary; the final results of the study will appear later in other publications. (LK)

39291 (USGS-OFR—76-842) **Radiometric and petrographic results for samples from drill holes GM-1 and GM-2, Granite Mountains, Wyoming.** Stuckless, J.S.; VanTrump, G. Jr.; Bunker, C.M.; Bush, C.A.; Hunter, W.C.; Lewis, N.F. Jr. (Geological Survey, Reston, Va. (USA)). 1976. 19p. TIC.

All conclusions reached in this paper are tentative. The volume of rock sampled by drill holes GM-1 and GM-2 is small compared to the outcrop area. Analyses of rocks collected over the entire outcrop area are currently underway to test the conclusions reached for the drill-core samples. Analyses are also being made on drill-core samples from the east end of the Granite Mountains. Our preliminary evaluation of the data from drill cores GM-1 and GM-2 suggests that statistical evaluations of uranium, thorium, and potassium data may be sufficient to indicate uranium mobility in granitic rocks. It is possible that uranium mobility may be suggested by a large standard deviation relative to the mean uranium content, a non-Gaussian distribution of uranium among samples as indicated by such measurements as skewness and kurtosis, and a failure of uranium values to correlate with either thorium or potassium contents.

39292 (USGS-OFR—76-851) **Chemical analysis and statistical data for water samples collected in Colorado, New Mexico, and Arizona as part of a study of surface-water and stream-sediment sampling techniques used in uranium exploration.** Burnside, S.S.; Wenrich-Verbeek, K.J. (Geological Survey, Reston, Va. (USA)). 1976. 314p. TIC.

Analytical data for surface-water samples taken from 16 sampling sites are presented. A statistical treatment of the data showing

histograms and frequency distributions, is also included. Samples were collected in the spring and summer of 1975 as part of a water and stream-sediment study to establish methods of sampling for uranium and other elements in surface waters. Stream sediments have been collected along with water samples at each site, and a similar statistical study of the corresponding data for sediment samples is in progress.

39293 (USGS-OFR—76-860) **Helium and radon-emanation bibliography. Selected references of geologic interest to uranium exploration.** Adkisson, C.W.; Reimer, G.M. (Geological Survey, Reston, Va. (USA)). 1976. 45p. TIC.

Selected references on helium and radon gas emanations and geologically related topics are given. There are 172 references primarily related to helium geology, 129 to radon geology, and 171 to helium and radon. These references are of geologic interest to uranium exploration. (LK)

39294 (USGS-OFR—76-861) **Multivariate analysis of geophysical and mineralogical data from uranium bearing sandstones.** Maxwell, E.L.; Kluth, M.J.; Weiner, M. (Geological Survey, Reston, Va. (USA)). 1976. 46p. TIC.

Purpose was to determine if borehole position relative to the "roll front" could be determined from geophysical and mineralogical data, and to evaluate the relative values of geophysical and mineralogical variables for hole position and redox state discrimination. Data from Bruni, Texas, Irigaray, Wyoming, and Lamprecht, Texas, were analyzed. (29 fig.)

39295 **Uranium and thorium abundances in Indian kimberlites.** Paul, D.K. (Leeds Univ. (UK)). *Geochim. Cosmochim. Acta;* **41**: No. 2, 335-339(Feb 1977).

Abundances of U and Th have been determined in 21 kimberlites from India by delayed fission neutron technique. Whole-rock U ranges from 1.87 to 3.93 ppM but Th shows wider variation from 14.02 to 60.44 ppM. Average Th/U ratios in three main diatremes are 7.9, 8.8 and 10.0. The interrelationships between U, Th, and K are variable and complex. A positive correlation exists between P_2O_5 and U and Th. Model calculations suggest that enrichment of U involved considerable mantle reaction during ascent.

FEED PROCESSING

39296 **Process for the preparation of uranium dioxide.** Watt, G.W.; Baugh, D.W. Jr. (to Exxon Nuclear Co., Inc.). US Patent 4,012,489. 15 Mar 1977. Filed date 21 May 1975. 8p.

An actinide dioxide, e.g., uranium dioxide, plutonium dioxide, neptunium dioxide, etc., is prepared by reacting the actinide nitrate hexahydrate with sodium dithionite as a first step; the reaction product from this first step is a novel composition of matter comprising the actinide sulfite tetrahydrate. The reaction product resulting from this first step is then converted to the actinide dioxide by heating it in the absence of an oxygen-containing atmosphere (e.g., nitrogen) to a temperature of about 500° to about 950°C for about 15 to about 135 minutes. If the reaction product resulting from the first step is, prior to carrying out the second heating step, exposed to an oxygen-containing atmosphere such as air, the resultant product is a novel composition of matter comprising the actinide oxysulfite tetrahydrate which can also be readily converted to the actinide dioxide by heating it in the absence of an oxygen-containing atmosphere (e.g., nitrogen) at a temperature of about 400° to about 900°C for about 30 to about 150 minutes. Further, the actinide oxysulfite tetrahydrate can be partially dehydrated at reduced pressures (and in the presence of a suitable dehydrating agent such as phosphorus pentoxide). The partially dehydrated product may be readily converted to the dioxide form by heating it in the absence of an oxygen-containing atmosphere (e.g., nitrogen) at a temperature of about 500° to about 900°C for about 30 to about 150 minutes. 16 claims.

ENRICHMENT

CENTRIFUGATION

39297 (ERDA-tr—280) **Separation device for uranium isotopes or the like.** 1975. Translation of German Patent 2,150,181. 5p. P 02/MF A01.

Improvements to a previously patented separation device are given. The flow velocity of the gas flowing in through a gas feed is equal to or greater than the flow velocity gas which is produced by centrifugal force in the rotor. One or several radial gas feed lines have a drive acting independently from each other and independently of the rotor. (LK)

39298 (ERDA-tr—281) **Apparatus for the separation of isotopes by centrifugal forces.** van Oordt, H.; van der Julius, A.; Hashmi, M. 1975. Translation of German Patent 2,037,030. 11p. P 02/MF A01.

An apparatus is described for the separation of isotopes by centrifugal forces. The apparatus contains a vacuum-tight separation chamber, in which a plasma containing ions of the isotopes which are to be separated is set into rotation around an axis by means of a radial electrical and an axial magnetic field. This apparatus assures a stable operation with modest resources. It is characterized by a high material throughput and a high elementary separation effect. (LK)

LASER EXCITATION

39299 (EPRI-NP—334) **Field ionization for laser isotope separation. Final report.** Gallagher, T.F.; Hill, R.M.; Edelstein, S.A. (Stanford Research Inst., Menlo Park, Calif. (USA). Molecular Physics Center). Dec 1976. 70p. P 04/MF A01.

The use of laser excitation for isotopic separations and particularly for the enrichment of uranium is under intensive investigation at many laboratories. Laser separation has been the subject of much publicity on claims of performance, but process details are generally classified. Scale-up from present small laboratory experiments to industrial practice requires extrapolation of laser and vacuum technology to reach reasonable efficiency, reliability, and producibility. For some cases of interest, it is evident that the requisite laser has not yet been obtained on even a laboratory scale. A concept for reducing the demands on laser technology is selective excitation of the source material in a manner that increases the effective cross-section for optical frequency energy interactions. (If the isotope of interest can be made into a better "target", the laser can be less efficient or selective.) Such potential is offered by creating "High Rydberg Number Atoms", an excitation state which serves to increase effective size of atoms to as much as 1000 times their normal values. The purpose of this study was to demonstrate that such excitation could be achieved and was, in principle, applicable to isotopic separation. The study achieved these initial objectives. It also became apparent that the basic processes examined might permit extension of available laser wavelengths as well as simplify scale-up problems related to throughput. These important results, which have been made available to ERDA and other researchers, may help to accelerate scale-up of laser methods. This report provides a background study of laser isotopic separation methods together with a description of field ionization methodology and experiments. Technical journal articles which further describe the work and its implications are provided.

39300 **Method for isotope enrichment by photoinduced chemilonization.** Dubrin, J.W. (to Energy Research and Development Administration). US Patent Application 683,156. 4 May 1976. 12p.

Isotope enrichment, particularly ^{235}U enrichment, is achieved by irradiating an isotopically mixed vapor feed with radiant energy at a wavelength or wavelengths chosen to selectively excite the species containing a desired isotope to a predetermined energy level. The vapor feed is simultaneously reacted with an atomic or molecular reactant species capable of preferentially transforming the excited species into an ionic product by a chemiionization reaction. The ionic product, enriched in the desired isotope, is electrostatically or electromagnetically extracted from the reaction system.

39301 **Isotope separation by photoselective dissociative electron capture.** Stevens, C.G. (to Energy Research and Development Administration). US Patent Application 696,997. 17 Jun 1976. 12p.

A method of separating isotopes based on photoselective electron capture dissociation of molecules having an electron capture cross section dependence on the vibrational state of the molecule is disclosed. A molecular isotope source material is irradiated to selectively excite those molecules containing a desired isotope to a predetermined vibrational state having associated therewith an electron capture energy region substantially non-overlapping with the electron capture energy ranges associated with the lowest vibration states of the molecules. The isotope source is also subjected to electrons having an energy corresponding to the non-overlapping electron capture region whereby the selectively excited molecules preferentially capture electrons and dissociate into negative ions and neutrals. The desired isotope may be in the negative ion product or in the neutral product depending upon the mechanism of dissociation of the particular isotope source used. The dissociation product enriched in the desired isotope is then separated from the reaction system by conventional means. Specifically, $^{235}UF_6$ is separated from a UF_6 mixture by selective excitation followed by dissociative electron capture into $^{235}UF_5$- and F.

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 39296, 39324

39302 (UCID—17354) **Encapsulation of UC—PuC mixture for calorimetric study.** Armstrong, R.E.; Link, R.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Dec 1976. Contract W-7405-ENG-48. 11p. P 02/MF A01.

Tantalum capsules lined with tantalum carbide were loaded with a mixture of uranium carbide-20 wt% plutonium carbide and sealed with an electron beam weld for use in Argonne National Laboratory calorimetric studies of reactor fuels. Experimental welding tests were made to determine optimum welding parameters. Special equipment available only at LLL was used and techniques were developed to perform the loading and welding operations without exposure to moisture or oxygen and with complete containment of the radioactive particles. Three capsules were successfully loaded, welded, tested, and delivered to ANL.

39303 Equipment for the production of spherical fuel and/or breeder particles of uranium dioxide for fuel and/or breeder elements for nuclear and breeder reactors. Cramer, J.; Hannen, W. (to Kernforschungsanlage Juelich G.m.b.H.). German(FRG) Patent 2,411,745/C/. 26 Feb 1976. 4p. (In German).

2 figs. Available from Dt. Patentamt, Muenchen (FRG). Addition to P 19602892.

An improvement of the apparatus to produce spherical uranium dioxide particles to be used for fuel and breeder elements in nuclear reactors is suggested. It is to ensure that all particles obtain a uniform spherical shape. The method starts with an aqueous uranyl nitrate, urea and hexamethylene tetramine containing solution which is dropped into a water-non absorbing liquid. The invention deals with a closing valve periodically shutting off the feeding tube, having a closing piston which controls the flow of liquid to the value. An advantageous geometric design of this apparatus part is described.

39304 Method for the production of spherical metal oxide or metal carbide particles. Hein, K.; Zimmer, E. (to Kernforschungsanlage Juelich G.m.b.H.). German(FRG) Patent 2,147,472/B/. 15 Apr 1976. 3p. (In German).

1 fig. Available from Dt. Patentamt, Muenchen (FRG).

The invention deals with the improvement of the method to produce spherical metal oxide or metal carbide particles which are to be used in particular as fuel or breeder materials for nuclear reactors. The metal oxide or metal carbide particles in aqueous solution are added dropwise to a Ketone phase above an aqueous ammonia solution. In order to ensure the spherical shape of the drops, a special ketone or ketone mixture is used for the ketone phase which slightly dissolves water (about 4 wt.%). Methyl isobutyl ketone is suitable here. Methyl cellulose or polyvinyl alcohol added to the aqueous metal salt solution is said to be advantageous.

39305 Electronic properties of mixed uranium-thorium monosulphides (Usub(x)Thsub(1-x))S. Danan, J.; de Novion, C.H.; Guerin, Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium); Wedgwood, F.A. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment); Kuznick, M. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). *J. Phys. (Paris);* 37: No. 10, 1169-1186(Oct 1976).

Bulk magnetization, neutron magnetic scattering and specific heat were measured between 1.5 and 300K for mixed uranium-thorium monosulphides (Usub(x)Thsub(1-x))S with large uranium concentrations ($x<=0.20$). Long-range ferromagnetic order is observed at low temperature for $0.43<x<=1$, but no long-range magnetic order occurs for $x<0.43$. Magnetization and Curie temperature decrease linearly with uranium content. The electronic specific heat is maximum at the critical concentration $x=0.43$. Experiments failed to reveal Schottky anomalies in specific heat or crystal-field levels by inelastic neutron scattering. Results favor a band description rather than a localized description for uranium 5*f* electrons.

39306 Parametric analysis of heat transfer in composite nuclear fuels. Rust, J.H.; Boyle, D.R. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering). *Nucl. Eng. Des.;* 39: No. 2-3, 241-247(Nov 1976).

The composite nuclear fuel described in this paper consists of a heat generating fuel matrix containing cylindrical metal and fibers uniformly aligned throughout the matrix. Exact analytical solutions were found for temperature distributions in the fiber and matrix for a composite cell modeled as concentric cylinders. A parametric study is presented of composite overall thermal conductivities and temperature distributions as a function of fiber-to-matrix conductivity ratios, cell length-to-radius ratios, and fiber-to-cell radius ratios. For composite cells in which length-to-radius ratios exceed 10, axial temperature distributions may be calculated assuming a homogeneous material.

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 39324, 39331, 39357, 39919, 39939, 40203, 40246

39307 (BNL—22443) Photochemical technique for reduction of uranium and subsequently plutonium in the Purex process. Goldstein, M.; Barker, J.J.; Gangwer, T. (Brookhaven National Lab., Upton, N.Y. (USA)). Sep 1976. Contract EY-76-C-02-0016. 21p. P 02/MF A01.

A photochemical modification of the Purex process is described in which a purified side stream of UO_2^{++} ion is reduced to U^{+4} outside the radioactive area of the reprocessing plant. The U^{+4} is then cycled back to step 2 of the Purex process to reduce the plutonium and effect separation within the partitioning column. This process is shown to be very energy efficient and compatible with existing conventional lamp technology. Preliminary cost estimates of the energy requirements for photon production are essentially negligible. Conceptual systems and photochemical reactor designs are presented. Potential benefits of this system are discussed.

39308 (DPST-LWR—76-1-4) Light water reactor fuel recycle, Savannah River Laboratory quarterly report, October—December 1976. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Mar 1977. Contract E(07-2)-1. 88p. P 05/MF A01.

The economics of seven alternatives for the back end of the nuclear fuel cycle were evaluated. For a 10-MTU/day reprocessing plant, annual operating costs of receiving facilities plus transportation would be $10.2 million/year higher if spent fuel is transported by truck rather than by rail. Calculations indicate that recycle of dissolved dirty scrap from MOX fuel fabrication to the LWR fuel separations plant is probably more economical than recycle within the MOX facility, although internal recycle is otherwise desirable. Test shearing of irradiated fuel rods from H. B. Robinson 2 reactor showed that hydraulic shearing is satisfactory. Dissolution tests were continued using irradiated UO_2 fuel to prepare feed for solvent-extraction studies. Solvent extraction flowsheets for the recovery and purification of uranium and plutonium from irradiated LWR fuel are being developed, based on SRP operating experience, theoretical calculations, and tests in miniature mixer-settlers. A conceptual process is being developed to convert plutonium nitrate solutions from solvent extraction and from mixed-oxide (MOX) recycle to a ceramic-grade plutonium oxide powder suitable for blending with UO_2 and fabrication into MOX fuel pellets. Safeguards required against materials theft or sabotage for a 10-MTU/day spent fuel reprocessing plant are being studied. A combined radiochemical extraction-neutron activation procedure was developed to determine ^{129}I in dissolver solution and off-gas caustic trap solutions. A simple colorimetric procedure was developed to determine traces of uranium in the presence of large amounts of fission products.

39309 (DPST-LWR—76-2-4) Light water reactor fuel recycle. Composite quarterly report, October—December 1976. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1976. Contract E(07-2)-1. 127p. P 07/MF A01.

Progress in the following areas is reported: economic studies; environmental studies; fuel receipt; head-end processes; off-gas treatment; Purex Process; finishing processes; waste management; environmental effects; and safeguards. The economics of seven alternatives for the back end of the nuclear fuel cycle has been evaluated. Average storage time for spent fuel was calculated, and current storage history was studied. Recovery of iodine from an off-gas stream by silver-loaded sorbents continued to be investigated. Chemical studies of LWR off-gas contaminants include CH_3I distribution between refrigerant liquid and vapor phases, nitrogen oxide solubility in R-12, and corrosion of stainless steel by CH_3I. Solvent extraction flowsheets for the Purex Process are being developed. The critical nuclides of primary environmental interest that would be released from a fuel reprocessing plant have been identified. The design basis incidents have been defined in the development of safeguards required against materials theft or sabotage for a 10 MTU/day fuel reprocessing plant. (LK)

39310 (GA-A—14126) Interim design status and operational report for semiremote handling fixtures: size reduction system. Ballard, A.S. (General Atomic Co., San Diego, Calif. (USA)). Feb 1977. Contract EY-76-C-03-0167-053. vp. P 09/MF A01.

Crushing of HTGR fuel elements is accomplished by a three-stage crushing system consisting of two overhead eccentric jaw crushers, a double-roll crusher, and an oversize reduction system to ensure complete reduction to the desired size. The crushing system is mounted in a special framework which enables gravity flow, eliminates material transport, and minimizes material holdup. The system has been designated UNIFRAME because of the integrated nature of the equipment. This report addresses the demonstration of semiremote maintenance of the crusher in a nonradioactive environment. Although the crusher maintenance system has some remote handling capability inherent in its design, the scope of this initial program is limited to the handling of selected components and allows for manual assistance in certain circumstances. This mode of operation is designated semiremote maintenance and is intended as an effort to gather experience.

39311 (ORNL/TM—5723) **LMFBR spent fuel reprocessing: a study of an industrial-scale facility.** Irvine, A.R.; Jones, F.J. (Oak Ridge National Lab., Tenn. (USA)). Mar 1977. Contract W-7405-ENG-26. vp. AT.

A scoping study of a large-scale reprocessing facility was performed as a means of identifying unresolved problems in the reprocessing of spent LMFBR fuels and developing general criteria for the conceptual design of a pilot plant to test and demonstrate such reprocessing. The results of the study are reported covering remote maintenance, feasibility of fluids recycle, flow diagram considerations, various aspects of facility design and arrangement, and the effects of variation in preprocessing decay time between 60 and 365 days. The study developed the rationale for significant portions of the pilot-plant criteria, which are presented.

39312 (GERHTR—153) **AKUT-II: an experimental plant for purifying the HTR loop of combustion waste gas.** Beaujean, H.; Vygen, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemische Technologie). Feb 1976. Translation of KFA-ICT-IB—402/76. 62p. P 04/MF A01.

A plant for the separation of aerosols, krypton and tritium (AKUT) used for purifying the head end of the reprocessing of thorium-containing fuel elements from combustion waste gases is described. Data are to be collected to enable a process engineer to plan and construct a large-scale plant, and the correctness and practicability of the concept adopted is to be proved in conjunction with the JUPITER plant. It is true that the tests on the AKUT I plant confirmed that the flow scheme was basically correct, but the actual experimental operation was considerably limited by a fixed and rigid coupling to the combustion furnace. Some operational conditions were encountered which did not meet the design values. Part of the plant (krypton separation) is being tested in the USA. The German concept was taken over in the early stages of tests and adapted to existing apparatuses, the result inevitably being different experimental conditions. The AKUT II plant can now be used for consideration of the economic and safety conditions, and comparisons can be made.

39313 **Device for continuous separation of particles from a liquid and for inserting the particles into a second liquid.** Ringel, H. (to Kernforschungsanlage Juelich G.m.b.H.). German(FRG) Patent 2,443,843/A/. 1 Apr 1976. 9p. (In German).

2 figs. Available from Dt. Patentamt, Muenchen (FRG).

A device is proposed allowing spherical heavy metal particles - especially such of radioactive material, as they are formed when reprocessing fuel elements for nuclear reactors - to be continuously and very carefully separated from a liquid and inserted into a second liquid without these two liquids getting into contact. The liquid containing the particles is fed to a sieve, desiqued as a drum or an endless belt system, retaining the particles on its surface, while the liquid is flowing off through a collecting cone. Moving on, the particles are stripped off the sieve by a second liquid arranged below the drum. The device is of simple design and allows an almost maintenance-free operation so that it is also suited for hot cells.

39314 **Transuranium elements in nuclear fuel reprocessing.** Bathelier, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Service d'Hydrometallurgie et de Chimie des Transuraniens). *Bull. Inf. Sci. Tech. (Paris);* No. 217, 7-16(Sep 1976). (In French).

Uranium and plutonium produce heavy elements (or transuranium elements) in nuclear fuels by neutron capture. During the recovery and purification treatment of uranium and plutonium the transuranium elements have to be eliminated as well as the fission products. In the TBP extraction process generally used, americium and curium are not extracted and follow easily the fission products in the wastes. Neptunium which is the intermediate element between uranium and plutonium is more difficult to separate, and is an usual pollutant of uranium. Its oxidation state depends on the ratio NO_2^-/NO_3^- and the acidity of the medium. These two factors are mainly responsible of its behavior during the fuel reprocessing. Low concentration of nitrous acid ($<10^{-3}$M) favors hexavalent neptunium extraction. On the contrary high concentration ($<10^{-2}$M) allows to maintain the major part of neptunium in the aqueous rafinate with the fission products.

39315 **Bidentate organophosphorus solvent extraction process for actinide recovery and partition.** Schulz, W.W. (to Energy Research and Development Administration). US Patent 3,993,728. 23 Nov 1976. Filed date 27 Aug 1975. 14p.

PAT-APPL-608-378.

A liquid-liquid extraction process for the recovery and partitioning of actinide values from acidic nuclear waste aqueous solutions, the actinide values including trivalent, tetravalent and hexavalent oxidation states is provided and includes the steps of contacting the aqueous solution with a bidentate organophosphorous extractant to extract essentially all of the actinide values into the organic phase. Thereafter the respective actinide fractions are selectively partitioned into separate aqueous solutions by contact with dilute nitric or nitric-hydrofluoric acid solutions. The hexavalent uranium is finally removed from the organic phase by contact with a dilute sodium carbonate solution.

39316 **Irradiated fuel reprocessing.** Ruiz, C.P.; Peterson, J.P. Jr. (to General Electric Co.). US Patent 4,011,296. 8 Mar 1977. Filed date 27 May 1975. 14p.

A process for separately recovering uranium, plutonium and neptunium substantially free of fission products from irradiated nuclear fuel is presented in which the fuel is dissolved in a strong mineral acid forming an aqueous dissolved nuclear fuel solution and treated to separate the uranium, plutonium and neptunium therefrom substantially free of said fission products by the sequential steps of solvent extraction, ion exchange and fluorination. The process has an improvement comprising the addition of a sufficient quantity of an additive of a stable metallic complex to the aqueous dissolved nuclear fuel solution prior to solvent extraction. This achieves improved purity of the separated uranium, plutonium and neptunium.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 39331

WASTE MANAGEMENT

39317 (PB—257307) **Radioactivity levels in the environs of the Rocky Flats Plutonium Plant, Golden, Colorado 1970.** (Environmental Protection Agency, Cincinnati, Ohio (USA). Water Quality Office). Apr 1971. 57p. NTIS $4.50.

During the week of February 23, 1970, representatives of the Water Quality Office visited the Rocky Flats Plant of the Atomic Energy Commission (AEC). The purpose of the visit was to obtain information on liquid radioactive waste management practices at the facility and the environmental surveillance activities in the plant environs. The report presents the findings of the February investigation. The discussion of the environmental levels of plutonium is limited to soil, water, and bottom sediment. (GRA)

39318 **High-level radioactive waste management.** Campbell, M.H. (ed.). Washington, DC; American Chemical Society (1976). 173p. (CONF-740349—P3).

From 167. national meeting of the American Chemical Society; Los Angeles, California, USA (31 Mar 1974).

Individual papers were indexed for inclusion in the energy data base. (LK)

39319 **Management of commercial high-level radioactive waste.** Pittman, F.K. (Energy Research and Development Administration, Washington, DC). pp 1-8 of In High-level radioactive waste management. Campbell, M.H. (ed.). Washington, DC; American Chemical Society (1976).

From 167. national meeting of the American Chemical Society; Los Angeles, California, USA (31 Mar 1974).

See CONF-740349—P3.

There is now available the technology which will allow us to contain the commercial high-level radioactive waste from the nuclear power industry. Through proper waste management controls we can reduce to acceptable levels the potential for public hazard and environmental damage. The AEC's program will provide retrievable storage for these solidified wastes in carefully maintained and monitored engineered facilities for the next several decades. During this period investigation and demonstration of waste disposal in a deep, stable, geologic formation will continue. After the completion of an extensive testing and demonstration program establishing the acceptability of the method of permanent disposal, the radioactive waste will be removed from the retrievable surface storage facility and disposed of permanently.

39320 **High-level radioactive waste management program at Nuclear Fuel Services.** Duckworth, J.P. (Nuclear Fuel Services, Inc., West Valley, NY). pp 72-83 of In High-level radioactive waste management. Campbell, M.H. (ed.). Washington, DC; American Chemical Society (1976).

From 167. national meeting of the American Chemical Society; Los Angeles, California, USA (31 Mar 1974).

See CONF-740349—P3.

The generation and management of high-level radioactive wastes from both Purex and Thorex type processing have been carried out since 1966. The Purex type waste represents combined high-level waste and intermediate-level waste neutralized and stored in multiconfined mild steel tanks. The Thorex waste which also contains the thorium is stored as an acid solution in stainless steel storage vaults. Future high-level waste management systems include multitank complex for five-year cooling and storage as an acidic solution. The location, structure, and multiple containment provides

protection against possible releases to the environment. Sketches of the storage systems and tables of waste compositions are included.

39321 High-level waste management research and development program at Oak Ridge National Laboratory. Blomeke, J.O.; Bond, W.D. (Oak Ridge National Lab. TN). pp 84-92 of In High-level radioactive waste management. Campbell, M.H. (ed.). Washington, DC; American Chemical Society (1976).

From 167. national meeting of the American Chemical Society; Los Angeles, California, USA (31 Mar 1974).

See CONF-740349—P3.

Projections of wastes to be generated through the year 2000 portend a problem of impressive size and complexity but one which can be handled within the framework of current and planned investigative programs. Investigations of the technical feasibility of removing actinide elements from wastes to render the residuals more manageable in terms of hazards and storage requirements indicate that they can be removed from wastes by the minimally desired factors of 10^2 to 10^4; however, demonstrations and engineering assessments of chemical flowsheets have yet to be made. Natural salt formations are believed to offer the best prospects for disposal of high-level wastes; other promising geological formations are also being evaluated for their suitability for use in the disposal of wastes.

WASTE PROCESSING

REFER ALSO TO CITATION(S) 39312, 39315, 39926

39322 (BNL—22312) **Immobilization of wet solid wastes at nuclear power plants.** Neilson, R.M. Jr. (Brookhaven National Lab., Upton, N.Y. (USA)). Jan 1977. Contract EY-76-C-02-0016. 12p. (CONF-770120—1). Dep. NTIS $3.50.

From Reactor radwaste management workshop; New Orleans, Louisiana, United States of America (USA) (12 Jan 1977).

Wet solid wastes are classified into four basic types: spent resins, filter sludges, evaporator concentrates, and miscellaneous liquids. Although the immobilization of wet solid wastes is primarily concerned with the incorporation of the waste with a solidification agent, there are a number of other discrete operations or subsystems involved in the treatment of these wastes that may affect the immobilized waste product. The immobilization process may be broken down into five basic operations: waste collection, waste pretreatment, solidification agent handling, mixing/packaging, and waste package handling. The properties of the waste forms that are ultimately shipped from the reactor site are primarily influenced by the methods utilized during the waste collection, waste pretreatment and mixing/packaging operations. The mixing/packaging (solidification) operation is perhaps the most important stage of the immobilization process. The basic solidification agent types are: absorbants, hydraulic cement, urea-formaldehyde, bitumen, and other polymer systems. (LK)

39323 (KY-G—400) **Solubility of gases in CCl_2F_2: a critical review.** Merriman, J.R. (Paducah Gaseous Diffusion Plant, Ky. (USA)). Mar 1977. Contract W-7405-ENG-26. 180p. P 09/MF A01.

CCl_2F_2 is being used as the process solvent in the development of a selective absorption process for the removal of Kr and Xe from contaminated nuclear process off-gas streams. A critical review of the published solubility data for solutions of gases in CCl_2F_2 indicates that the available data for N_2, O_2, and Ar are not sufficiently reliable for use in support of the absorption process studies. This judgment is based on the scatter of the data, suspicious temperature and pressure variations, conflicts with other solubility data, conflicts with absorption process pilot plant results, and an apparent lack of thermodynamic consistency. In the absence of good experimental solubility data, it is necessary to turn to estimating procedures to obtain solubilities which are more useful. Several such procedures, ranging from the simple concept of ideal solubility to statistical thermodynamics techniques are reviewed in this report. Two of these, one based on experimental solubility/entropy of solution data for other gas-liquid systems and the other based on the regular solution model appear to be most applicable to the problem of estimating equilibrium coefficients over the temperature ranges of interest in the absorption process development work. Estimates made using these approaches are included for solutions of N_2, O_2, Ar, and other components in CCl_2F_2. Similar estimates are also provided for other systems which are of practical and/or theoretical interest.

39324 (UCRL—52123(Rev.1)) **Review of monitoring instruments for transuranics in fuel fabrication and reprocessing plants. A progress report to the physical and technological programs, Division of Biomedical and Environmental Research, U.S. Energy Research and Development Administration.** Kordas, J.F.; Phelps, P.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Mar 1977. Contract W-7405-ENG-48. 82p. P 05/MF A01.

A comprehensive review of the monitoring instruments for transuranic elements released from nuclear fuel fabrication and reprocessing plants has been compiled. The extent of routine operational releases has been reviewed for the light water reactor (LWR) fuel cycle (including plutonium recycle), the breeder reactor fuel cycle, and the high-temperature gas cooled reactor (HTGR) fuel cycle. The stack monitoring instrumentation that is presently in use at the various fabrication and reprocessing plants around the country is examined. Sampling difficulties including the inlet-probe arrangement and the effectiveness of the entire sampling system are discussed, as are the measurement problems for alpha-emitting, long-lived, transuranic aerosols, ^{129}I, ^{106}Ru, and tritium oxide. The potential problems in the HTGR fuel cycle such as the measurement of releases of alpha-emitting aerosols and of gaseous releases of ^{220}Rn and ^{14}C are also considered. Monitoring requirements range from the detection of low-level, routine releases to high-level accidental releases. Both first and second kinds of detection errors are considered in a discussion of adequate detection limits. The presently deployed monitors are critically examined in this light and the drawbacks and limitations of each are noted. Prototype instrumentation is studied, including Argonne's mechanical separation technique, Battelle's mass separation by surface ionization method, and in particular, LLL's transuranic aerosol measurement system. The potentials, sensitivities, advantages, and limitations of each system are enumerated. The additional potential uses of the LLL system are also discussed.

39325 (ORNL-tr—4331) **Processing of combustible α-wastes. A summary of research and development to date with an evaluation of the development potential of the processes.** Wieczorek, H.; Hild, W. (Kernforschungszentrum Karlsruhe (Germany, F.R.)). 1976. Translation of KFK—2250. 30p. P 03/MF A01.

On the basis of currently available literature six processes involving the oxidative treatment of combustible α-bearing wastes are described and discussed. The Wet Combustion in sulfuric/nitric acid at 250°C has the highest development potential. This is due to a relatively simple process, a relative low apparative requirement and the possibility of Plutonium recovery.

39326 Solid forms for Savannah River Plant radioactive wastes. Wallace, R.M.; Hale, W.H.; Bradley, R.F.; Hull, H.L.; Kelley, J.A.; Stone, J.A.; Thompson, G.H. (Savannah River Lab., Aiken, SC). pp 9-30 of In High-level radioactive waste management. Campbell, M.H. (ed.). Washington, DC; American Chemical Society (1976).

From 167. national meeting of the American Chemical Society; Los Angeles, California, USA (31 Mar 1974).

See CONF-740349—P3.

Methods are being developed to immobilize Savannah River Plant wastes in solid forms such as cement, asphalt, or glass. ^{137}Cs and ^{90}Sr are the major biological hazards and heat producers in the alkaline wastes produced at SRP. In the conceptual process being studied, ^{137}Cs removed from alkaline supernates, together with insoluble sludges that contain ^{90}Sr, will be incorporated into solid forms of high integrity and low volume suitable for storage in a retrievable surface storage facility for about 100 years, and for eventual shipment to an off-site repository. Mineralization of ^{137}Cs, or its fixation on zeolite prior to incorporation into solid forms, is also being studied. Economic analyses to reduce costs and fault-tree analyses to minimize risks are being conducted. Methods are being studied for removal of sludge from (and final decontamination of) waste tanks.

39327 High-level radioactive waste management program at the National Reactor Testing Station. Slansky, C.M. (Allied Chemical Corp., Idaho Falls, ID). pp 31-53 of In High-level radioactive waste management. Campbell, M.H. (ed.). Washington, DC; American Chemical Society (1976).

From 167. national meeting of the American Chemical Society; Los Angeles, California, USA (31 Mar 1974).

See CONF-740349—P3.

A status report is given on high-level radioactive waste management at the irradiated fuel reprocessing plant (ICPP) at the National Reactor Testing Station (Idaho National Engineering Laboratory). Interim storage of high-level liquid waste, calcination of liquid waste by fluidized bed calcination and storage of calcine in bins is summarized over the past decade. Results are given on the conversion of granular calcine to cermet, glass-ceramic, and ceramic forms for alternative long-term storage requirements. The environmental impact of effluents released in the course of waste solidification is given for the ICPP.

39328 Solidification and storage of Hanford's high-level radioactive liquid wastes. Schulz, W.W.; Kupfer, M.J. (Atlantic Richfield Hanford Co., Richland, WA). pp 54-71 of In High-level radioactive waste management. Campbell, M.H. (ed.). Washington, DC; American Chemical Society (1976).

From 167. national meeting of the American Chemical Society; Los Angeles, California, USA (31 Mar 1974).

See CONF-740349—P3.

When the present Hanford Waste Management program is completed in 1980, approximately 140 million liters of solid salt cake,

produced by evaporation of aged radioactive liquid waste will be stored in underground mild steel tanks. Additionally, megacuries of ^{90}Sr and ^{137}Cs will have been removed from Hanford waste solutions, converted to solid $^{90}SrF_2$ and $^{137}CsCl$, and stored underwater in doubly encapsulated metallic containers. Several alternative modes for long-term storage/disposal of these high-level wastes are presently being evaluated. For some of these modes conversion of the solids to immobile silicates of low water solubility may be desirable. Laboratory-scale studies of both low and high temperature processes for preparation of silicate minerals and glasses are in progress; status of the work is reviewed.

39329 High-level radioactive waste management research and development program at Battelle Pacific. Mendel, J.E.; McElroy, J.L.; Platt, A.M. (Battelle Pacific Northwest Labs., Richland, WA). pp 93-107 of In High-level radioactive waste management. Campbell, M.H. (ed.). Washington, DC; American Chemical Society (1976).

From 167. national meeting of the American Chemical Society; Los Angeles, California, USA (31 Mar 1974).

See CONF-740349—P3.

Solidified waste forms for the immobilization of high-level radioactive wastes from the commercial reprocessing of power reactor fuels, and processes for the reliable production of the waste forms, are being developed at Battelle-Northwest. The development program has started out on a nonradioactive laboratory and pilot plant scale, and will be carried through fully radioactive engineering-scale demonstrations of the processes. Current development is emphasizing silicate glass or glass-ceramic forms, produced in a two-step, calcination-melting process. Depending upon the waste composition, the glasses or glass-ceramics can contain over 25 wt % fission products and 2 wt % actinides, creating unique problems in assuring long-term stability.

39330 Fixation of radioactive waste by hydrothermal reactions with clays. Barney, G.S. (Atlantic Richfield Hanford Co., Richland, WA). pp 108-125 of In High-level radioactive waste management. Campbell, M.H. (ed.). Washington, DC; American Chemical Society (1976).

From 167. national meeting of the American Chemical Society; Los Angeles, California, USA (31 Mar 1974).

See CONF-740349—P3.

A means of converting high-level radioactive waste containing sodium salts to solid, relatively insoluble aluminosilicate minerals, is described. Powdered aluminum silicate clays such as kaolin or bentonite are allowed to react with caustic, aqueous solutions of the waste at temperatures in the range of 30° to 100°C. The reaction product from nitrate-containing wastes is a salt-filled, sodium aluminosilicate with the framework structure of cancrinite. Radioactive cesium and strontium are trapped in cancrinite along with sodium salts. The cancrinite crystals are spheres approximately 0.5 μm in diameter and are clustered. Leaching of the powdered product with distilled water at 30°C gives bulk leach rates in the range of 10^{-7} to 10^{-9} g of sample/cm^2-day based on BET surface areas.

39331 Removal of cesium and strontium from fuel storage basin water. Wilding, M.W.; Rhodes, D.W. (Allied Chemical Corp., Idaho Falls, ID). pp 134-151 of In High-level radioactive waste management. Campbell, M.H. (ed.). Washington, DC; American Chemical Society (1976).

From 167. national meeting of the American Chemical Society; Los Angeles, California, USA (31 Mar 1974).

See CONF-740349—P3.

Spent fuel from nuclear reactors is stored underwater at the Idaho Chemical Processing Plant for cooling and shielding before processing. The fuel storage basin water becomes contaminated with fission products, primarily cesium-137 and strontium-90, from fuel elements that "leak" and from cut pieces of fuel and miscellaneous scrap contained in cans, which are vented to release gases. This report describes laboratory research and plant-scale tests of candidate ion-exchange materials for removing cesium-137 and strontium-90 from the contaminated storage basin water, which contains moderate quantities of nonradioactive dissolved solids. Cesium-137 is removed by a zeolitic ion-exchange material; strontium-90 is removed by an organic ion-exchange resin. Operational experience with plant-size ion-exchange columns indicates that both cesium-137 and strontium-90 are removed effectively by ion exchange.

39332 Radioactive waste management development in Europe. Walton, R.D. Jr. (Energy Research and Development Administration, Washington, DC). pp 158-160 of In High-level radioactive waste management. Campbell, M.H. (ed.). Washington, DC; American Chemical Society (1976).

From 167. national meeting of the American Chemical Society; Los Angeles, California, USA (31 Mar 1974).

See CONF-740349—P3.

Germany, England, and France are vigorously developing technology and methodology for incorporating high-level radioactive waste into silicate glass. Germany is concentrating on a spray calcination vitrification system. England has selected a rising level glass process in which evaporation, calcination, and borosilicate glass vitrification all take place in a heated pot. France is operating a small-scale batch pot calcination-batch vitrification system and developing a new continuous system using a rotary calciner and melter with batchwise draw-off.

39333 Nuclear waste solidification. Bjorklund, W.J. (to Energy Research and Development Administration). US Patent Application 675,086. 8 Apr 1976. 10p.

High level liquid waste solidification is achieved on a continuous basis by atomizing the liquid waste and introducing the atomized liquid waste into a reaction chamber including a fluidized, heated inert bed to effect calcination of the atomized waste and removal of the calcined waste by overflow removal and by attrition and elutriation from the reaction chamber, and feeding additional inert bed particles to the fluidized bed to maintain the inert bed composition.

39334 Method of encapsulating solid radioactive waste material for storage. Bunnell, L.R.; Bates, J.L. (to Energy Research and Development Administration). US Patent 3,993,579. 23 Nov 1976. Filed date 22 Oct 1975. 6p.

PAT-APPL-624,805.

High-level radioactive wastes are encapsulated in vitreous carbon for long-term storage by mixing the wastes as finely divided solids with a suitable resin, formed into an appropriate shape and cured. The cured resin is carbonized by heating under a vacuum to form vitreous carbon. The vitreous carbon shapes may be further protected for storage by encasement in a canister containing a low melting temperature matrix material such as aluminum to increase impact resistance and improve heat dissipation. 8 claims.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 39328, 39334, 39909

39335 (BNWL—2184) Initial site characterization and evaluation of radionuclide contaminated soil waste burial grounds. Phillips, S.J.; Reisenauer, A.E.; Rickard, W.H.; Sandness, G.A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1977. Contract EY-76-C-06-1830. 68p. P 04/MF A01.

A survey of historical records and literature containing information on the contents of 300 Area and North Burial Grounds was completed. Existing records of radioactive waste location, type, and quantity within each burial ground facility were obtained and distributed to cooperating investigators. A study was then initiated to evaluate geophysical exploration techniques for mapping buried waste materials, waste containers, and trench boundaries. Results indicate that a combination of ground penetrating radar, magnetometer, metal detector, and acoustic measurements will be effective but will require further study, hardware development, and field testing. Drilling techniques for recovering radionuclide-contaminated materials and sediment cores were developed and tested. Laboratory sediment characterization and fluid transport and monitoring analyses were begun by installation of in situ transducers at the 300 North Burial Ground site. Biological transport mechanisms that control radionuclide movement at contaminated sites were also studied. Flora and fauna presently inhabiting specific burial ground areas were identified and analyzed. Future monitoring of specific mammal populations will permit determination of dose rate and pathways of contaminated materials contained in and adjacent to burial ground sites.

39336 (DP—1438) Technical assessment of the bedrock waste storage at the Savannah River Plant. Bradley, R.F.; Corey, J.C. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Nov 1976. Contract E(07-2)-1. vp. P 14/MF A01.

An assessment of the safety and feasibility of ultimate storage of radioactive wastes produced at the Savannah River Plant (SRP) in horizontal tunnels excavated in the bedrock beneath the plant site is presented. Results indicate that a cavern with an excavated volume of 130 million gallons could contain 80 million gallons of concentrated radioactive SRP wastes with minimal risks if the cavern is located in the impermeable Triassic Basin underlying the Savannah River site. The cavern could be placed so that it would lie wholly within the boundaries of the plantsite. The document summarizes the general geological, hydrological, and chemical knowledge of the geological structures beneath the plantsite; develops evaluation guidelines; and utilizes mathematical models to conduct risk analyses. The risk models are developed from known soil and salt solution mechanics; from past, present, and future geological behavior of the onsite rock formations; and from known waste handling technology. The greatest risk is assessed to exist during transfer of the radioactive wastes to the cavern. When the cavern is filled and sealed, further population risks are asessed to be very low.

39337 (LA—6575-PR) Investigations of the Oklo natural fission reactor, July 1975—June 1976. Apt, K.E. (comp.). (Los Alamos

Scientific Lab., N.Mex. (USA)). Nov 1976. Contract W-7405-ENG-36. 69p. P 04/MF A01.

This document reports on activities of the Oklo natural fission reactor program. During FY 76, studies have been directed toward (1) further characterization of the reactor, including operation, radionuclide production and dispersion, and ore paragenesis, (2) theoretical prediction of the geochemical behavior of reactor products, (3) search for evidence for other natural fission reactors, and (4) supportive analytical measurements and procedures development. These investigations are conducted by personnel at the Los Alamos Scientific Laboratory, the Allied Chemical Idaho National Engineer Laboratory, and the Department of Geology of the University of New Mexico and are in conjunction with the ERDA program for geologic isolation of nuclear fuel cycle wastes.

39338 (ORNL/Sub/4269—9) **Design aspects of the alpha repository. II. Conceptual layouts of underground storage facilities.** Grams, W.H. (RE/SPEC, Inc., Rapid City, S.Dak. (USA)). 30 Jun 1975. Contract W-7405-ENG-26;SUB-4269. 82p. Dep. NTIS $5.00.

Five conceptual repository layouts are presented: linear repository, 1 panel; bow tie repository, 2 panels; maltese cross repository, 4 panels; snowflake repository; 5 panels, and sash window repository, 8 panels. The layouts are compared with respect to excavation requirements, haulage distances, ventilation flow path designs, and safety features. (LK)

39339 (PB—260559) **Status of commercial nuclear high-level waste disposal. Special report.** Dau, G.J.; Williams, R.F. (Electric Power Research Inst., Palo Alto, Calif. (USA). Nuclear Systems and Materials Dept.). Sep 1976. 86p. (EPRI-NP—44-SR). Q 05/MF A01.

The results of this review, presented in the form of a functional description of high level waste management system, shows that technology is available to dispose of nuclear waste safely by several different processes. The most attractive alternative in terms of available technology and shortness of time to demonstrate it at commercial scale is a system that converts the waste to a solid by immobilizing the radioactive elements in a glass matrix. Brief comments are also given on international efforts in high level waste management and advanced disposal concepts. (GRA)

39340 (Y/OWI/TM—15) **Selected charts: National Waste Terminal Storage Program.** Zerby, C.D. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Office of Waste Isolation). 16 Feb 1977. Contract W-7405-ENG-26. 27p. P 03/MF A01.

Copies of figures and tables used in the presentation to Charles C. Finch, Governor of Mississippi, are compiled. (LK)

39341 (Y/OWI/TM—17) **Selected charts: National Waste Terminal Storage Program.** Zerby, C.D. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Office of Waste Isolation). Mar 1977. Contract W-7405-ENG-26. 29p. P 03/MF A01.

Copies of figures and tables used in the presentation to the Webster and Bienville Parishes of Louisiana are compiled. (LK)

39342 **Distribution of plutonium in a rock containment environment.** Fried, S.; Friedman, A.M.; Weeber, R. (Argonne National Lab., IL). pp 126-133 of In High-level radioactive waste management. Campbell, M.H. (ed.). Washington, DC; American Chemical Society (1976).

From 167. national meeting of the American Chemical Society; Los Angeles, California, USA (31 Mar 1974).

See CONF-740349—P3.

Studies of the migration of Pu in limestones and basalts indicate that the absorption coefficients are dependent on the types and amounts of other ions present in the solution. Migration coefficients were measured for flow along the surface of fissures and through the porous stone. At least two chemical forms of Pu were present in neutral solutions and one of these, presumably a polymerized Pu oxide, migrated 10 times faster than the other form.

39343 (PB—258164) **Preliminary data on the occurrence of transuranium nuclides in the environment at the radioactive waste burial site Maxey Flats, Kentucky.** Meyer, G.L. (Environmental Protection Agency, Washington, D.C. (USA). Office of Radiation Programs). Feb 1976. 84p. (EPA—520/3-75/021). NTIS $5.00.

Between 1963 and 1974, approximately 104,000 cu m of solid 'low-level' radioactive waste were buried at the Maxey Flats, Kentucky, site. These wastes contained approximately 80 kg of ^{239}Pu and a large undetermined quantity of other plutonium isotopes. In 1972, elevated levels of radioactivity were detected in monitoring samples collected near the burial facility by the Kentucky Department for Human Resources (KDHR). Subsequently, the KDHR conducted a special radiological study of the burial site and its environs. Based on the concentration of plutonium present or the ratio of plutonium-238 to -239, 49 of 50 samples collected on or near the burial site were contaminated with plutonium from a source other than atmospheric fallout. Plutonium was detected in surface soil, in soil cores 90 cm deep, in monitoring wells, and in streams which drain the site. This paper presents the plutonium data with interpretations of its occurrence and possible significance from a hydrogeological and environmental perspective. (GRA)

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 39343, 39347, 40195, 40198, 40200, 40203, 40246

39344 (IAEA-CN—36/522) **Public acceptance of nuclear power in the United States - the role of the national environmental policy act.** Jellinek, S.D.; Brubaker, G.L. (International Atomic Energy Agency, Vienna (Austria)). 1977. 14p. (CONF-770505—294). U 02/MF A01.

From International conference on nuclear power and its fuel cycles; Salzburg, Austria (2 May 1977).

5.0.-.P.1./03.

The passage of the National Environmental Policy Act (NEPA) in 1969, required all U.S. Federal agencies to build consideration of the environmental impacts of their proposed activities into their decisionmaking process. It also established the Council on Environmental Quality (CEQ) within the Executive Office of the President to oversee its implementation, and to serve as the principle environmental policy adviser to the President. Agency environmental analyses are documented in an environmental impact statement (EIS) which is prepared prior to deciding if a project or a proposal is to be approved. Today the EIS is the foremost document used by both the Energy Research and Development Administration and the Nuclear Regulatory Commission to achieve public understanding and acceptance of nuclear power facilities in the U.S. At the center of the NEPA process is the opportunity for public comment on proposed projects. Initial public concern was with thermal pollution and the traditional environmental impacts related to power plant construction and operation. Recent interests, however, have been with larger policy issues related to safeguards and management of radioactive wastes. The role of the EIS in resolving these current issues and its role in the debate over future nuclear development in the U.S. is discussed. The provisions of NEPA are representative of the increasing trend worldwide toward greater public involvement in decisions on technology which can affect the future. The development and integration of the EIS into the U.S. nuclear decisionmaking process can provide interesting and valuable insights to other nations concerning the achievement of better public understanding and acceptance of nuclear power through public involvement in the decision process.

39345 **Biosorption isotherm for uranium recovery.** Chiu, Y. (George Washington Univ., Washington, DC); Asce, M.; Zajic, J.E. *J. Environ. Eng. Div., Am. Soc. Civ. Eng.;* **102**: No. EE5, 1109-1111(Oct 1976).

An analysis of the biological sorption of uranium on mycelia of Penicillium C-1 is provided. From an isotherm test, a rough estimate of the biomass, required for removal of uranium to a certain level can be attained. The process presents a new approach towards water pollution control and resource recovery. The biosorption method may find its greatest application in solutions of low uranium concentration (100 ppM to 300 ppM) such as in waste mine water or very lean leach solutions. (RAF)

39346 **High-level radioactive waste from light-water reactors.** Cohen, B.L. (Department of Physics, University of Pittsburgh, Pittsburgh, PA 15260). *Rev. Mod. Phys.;* **49**: No. 1, 1-20(Jan 1977).

The production of radioactive nuclei during the operation of a light-water reactor is traced, and their decay history is followed. The potential environmental impacts of this waste are calculated and shown to be comparable to those of other materials we produce. Assuming deep burial, it is shown that there are important time delays which prevent the waste from reaching the biosphere in the first few hundred years while its toxicity is decreasing by several orders of magnitude. In the long term,,the most important pathway to man was found to be through groundwater into food and water supplies, with consequences calculated t to be 0.4 fatalities in 10^6 years from each year of all-nuclear power in U.S. Other pathways considered and found to be less important include meteorites, volcanism, release through ground water to airborne particulate, and human intrusion by drilling and mining for unspecified materials and for salt. For time scales longer than 10^6 years, nuclear power is shown to reduce man's exposure to radiation by consuming uranium. A cost-benefit analysis is developed for surveillance of buried waste. It is shown that buried high-level waste is environmentally much less dangerous than uranium mill tailings.

HEALTH AND SAFETY

39347 (RFP—2462) **Probabilities of aircraft crashes at Rocky Flats and subsequent radioactive release.** Selvidge, J.E. (Atomics

International Div., Golden, Colo. (USA)). 12 Apr 1977. Contract EY-76-C-04-3533. 20p. P 02/MF A01.

The probability of a small airplane from Jefferson County Airport (Jeffco) or Stapleton International Airport crashing into a plutonium area at the Rocky Flats Plant has been calculated at 1.4 x 10^{-4} and 4.2 x 10^{-6} per year, respectively. The probability of such a crash involving a large airplane from Jeffco or Stapleton is 3.5 x 10^{-6} and 1.1 x 10^{-6} per year, respectively. Overall, the chance of an aircraft of any size, or any type, and from any source crashing into a plutonium area at Rocky Flats is 2.88 x 10^{-4} per year. An event tree was developed to cover every plausible series of events leading to a release of plutonium in the range of 0 to 1000 grams. Selected results show an annual release probability of 3.9 x 10^{-5} for less than 0.5 grams, 5.8 x 10^{-6} for 50 to 70 grams, 5.6 x 10^{-8} for 200 grams, and 6.4 x 10^{-10} for 1000 grams. Calculations led to a weighted average release amount of 3.7 x 10^{-4} grams of plutonium per year. Because of conservative assumptions, it is estimated that these probabilities are high by a factor of about two for small aircraft and 10 for large aircraft.

39348 (TID—3352) **Occupational health aspects of uranium. A selected bibliography.** (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). 1977. 129p. P 07/MF A01.

The bibliography contains 716 references selected from Volumes 1 through 33 (1948—1976) of Nuclear Science Abstracts. Citations of foreign and domestic research reports, journal articles, patents, conferences, and books are included. (JRD)

39349 Minimum critical mass of plutonium—polyethylene system found to be significantly lower than plutonium—water system. Thompson, J.K. (Battelle-Pacific Northwest Labs., Richland, WA). *Nucl. Technol.;* **33**: No. 2, 235-236(Apr 1977).

Theoretical homogeneous plutonium-polyethylene mixtures have significantly lower critical masses than theoretical homogeneous plutonium-water mixtures of comparable H Pu ratio for H/Pu ratios close to optimum. The minimum critical mass for an optimally moderated, full water-reflected, homogeneous plutonium-polyethylene mixture in spherical geometry has been calculated to be approximately 360 g plutonium (+-5% for cross-section uncertainties) compared to approximately 530 g plutonium for a plutonium-water mixture under the same conditions. The 30 percent drop in critical mass is attributable to increased hydrogen atom density and the superior moderating characteristics of carbon over oxygen combined with a higher carbon atom density in polyethylene (rho = 0.96 Mg/m^3) than oxygen atom density in water (rho = 1.0 Mg/m^3).

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 39925

39350 (K/CSD/TM—10) **Nuclear materials management and safeguards system: reports.** (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). Feb 1977. Contract W-7405-ENG-26. 149p. Dep. NTIS $6.00.

This manual is the second in a series of three user manuals developed to improve the utility and understanding of the Nuclear Materials Management and Safeguards System (NMMSS). They describe the logical role and physical characteristics of the system, the information represented in the data that enters the system and remains in its data base, and the performance of the system in continuously and simultaneously serving the many organizations that use it. The first manual in this series is an overview of the NMMSS. It was issued in October, 1976, and is identified as User Manual NMMSS-1. The overview was compiled to give a comprehensive description of the concept, design, development, operation, and use of the system. The manual on reports is designated as User Manual NMMSS-2, and it gives a closer, more detailed view of the system and how it is used by many organizations with safeguards and management responsibilities. Usage is represented in the descriptions of reports and the other information products of the national data base that is maintained by the system. The third manual will describe the data categories and components of the four primary and eight background data systems. It will include descriptions and definitions of data elements and summaries of the reporting specifications.

39351 (LA—6574) **Measurement reliability for nuclear material assay.** Reilly, T.D.; Evans, M.L. (Los Alamos Scientific Lab., N.Mex. (USA)). Jan 1977. Contract W-7405-ENG-36. 137p. P 07/MF A01.

This report discusses the reliability of nuclear material assay (including analytical chemistry, calorimetry, and nondestructive nuclear methods). The assay of feed, product, scrap, and waste is considered. Ranges of accuracy and precision are given.

39352 (LA—6709-PR) **NDA technology for uranium resource evaluation.** Menlove, H.O. (comp.). (Los Alamos Scientific Lab., N.Mex. (USA)). Feb 1977. Contract W-7405-ENG-36. 9p. P A02/MF A01.

The following progress report describes the work performed during the first quarter on the contract for NDA Technology for Uranium Resource Evaluation. The initial phases of the work focused on gamma-ray calculations and computer code modifications in support of borehole logging measurements and surface gamma-ray surveys. The existing gamma-ray transport computer codes at Los Alamos Scientific Laboratory are being modified to give the energy group resolution desired for the uranium calculations. Monte Carlo computer calculations have been compared with the discrete ordinates ONETRAN code results for simple cases to gain confidence in the results. Preliminary calculations have been performed to investigate the applicability of transport and Monte Carlo computer calculations to uranium ore measurements. Feasibility studies are in progress to investigate the use of a photoneutron source for direct measurement of the uranium concentration surrounding a borehole. An ^{124}Sb-Be neutron source was used for the initial laboratory test experiments, and a ^{4}He gas proportional counter was used to count the induced prompt fission neutrons. A new approach is being investigated for producing photoneutrons by means of converting a beta-decay source to a bremsstrahlung spectrum.

39353 (PB—260584) **Plutonium: facts and inferences.** Comar, C.L.; Seefeldt, W.B.; Mecham, W.J.; Steindler, M.J.; Cohen, B.L. (Electric Power Research Inst., Palo Alto, Calif. (USA)). Aug 1976. 163p. (EPRI/EA—43-SR). Q 08/MF A01.

This report reviews the knowledge that we have about plutonium from the point of view of the inferences that can be drawn from such knowledge relative to the implications for society of the creation of this element in a nuclear power industry. It represents a detailed source of information that should be helpful in promoting an understanding of the issues. An idea of the content can be gained from the chapter titles: (1) Properties of Plutonium; (2) Release of Plutonium into the Environment from the Nuclear Power Industry; (3) Plutonium in the Biosphere; (4) Plutonium and Human Beings; (5) Diversion of Plutonium for Malevolent Purposes. In the report itself there was an attempt to avoid stating conclusions. However, the contributing authors did express a general view based on their collective experiences. (GRA)

39354 (SAND—76-0500) **EASI approach to physical security evaluation.** Bennett, H.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1977. Contract EY-76-C-04-0789. 35p. (NUREG—760145). P 03/MF A01.

A simple, easy to use method, called Estimate of Adversary Sequence Interruption (EASI), has been developed to evaluate physical security system performance under specified conditions of threat and system operation. The method consists of a probabilistic analysis of the interactions of basic security functions, such as detection, communications, response, etc. The evaluation can be performed on a hand-held programmable calculator. The results of the analysis are expressed in terms of the probability that the physical protection system can respond in time to interrupt specific adversary action sequences. The following input data is required: (1) Detection probability for each sensor or other means of detection. (2) Probability of communication to response force or other means of response. (3) Mean and standard deviation of response time. (4) Mean and standard deviation of the time to perform each task in the adversary action sequence. The utility of the method depends upon the user's ability to identify significant adversary action sequences and to obtain data which properly reflect conditions created by the adversary action sequence of interest. The objective of the development is to provide a usable evaluation method which could serve as either a physical protection system design aid or as a decision aid in the licensing and inspection process. As such, it is recommended that EASI be utilized on a limited trial basis to provide information on the utility of the method and to clarify user's needs.

39355 (SAND—77-0452C) **Shortest path algorithms applied to nuclear safeguards problems.** (Sandia Labs., Albuquerque, N.Mex. (USA)). Feb 1977. Contract EY-76-C-04-0789. 7p. P 02/MF A01.

Slides used in the presentation are compiled. (LK)

39356 Dynamic safeguards accounting and material control via modern estimation methods. Alspach, D.L.; Greenlee, T.L. (ORINCON Corp., La Jolla, CA). pp 145-151 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

With the growth of the nuclear power industry and its associated fuel fabrication and reprocessing plants, the need for realtime material accounting (safeguards accounting) becomes increasingly clear. In order to achieve real-time material control with high accuracy and short lag times one will be forced to adopt a

computer based on-linc accounting system. The use of a computer based system makes it possible to consider the incorporation of modern computational techniques for state estimation and system identification in the accounting scheme. These computer-based methods can produce "optimal", or highly accurate, real-time estimates of the amount of material in process. Such estimates will be required to insure the accountability of nuclear material in process and thereby aid in the solution of the nuclear safeguards problem.

39357 Optimal identification as a method for dynamic measurement of in-process inventory in nuclear reactor fuel reprocessing. Zivi, S.M. (Argonne National Lab., IL). pp 152-156 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976). See CONF-760703—.

A specific dynamic inventory method is analyzed by the simulation of a hypothetical plant and the simulation of measurements, including random errors, for the purpose of estimating the inventory of in-process material.

39358 (PB—256962) **Report to the Congress on the need for, and the feasibility of, establishing a security agency within the Office of Nuclear Material Safety and Safeguards.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Nuclear Material Safety and Safeguards). Aug 1976. 150p. (NUREG—0015). NTIS $6.00.

See also PB—256963. Report on Security Agency Study.

In response to the Congressional mandate Section 204(b)-(2) (C) of the Energy Reorganization Act of 1974, the Director of the Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission (NRC) has assessed the need for and the feasibility of establishing a security agency within that office for the performance of safeguards functions. The study assessed guard force effectiveness, and addressed public policy, administrative and legal issues. The study concluded that creation of a special security force within NRC would not result in a higher degree of guard force effectiveness than can be achieved through the use of private guards who have been properly trained and certified. Disparate gun laws in various states, it concluded, restrict arms possessed by both private and federal guards and private and federal transportation guards would require legislation authorizing them to bear the necessary weapons to protect nuclear material in transit. The role of reaction forces was also addressed and it was concluded that primary reliance at fixed sites should be placed on onsite protection systems; for material in transit, on invulnerability of vehicles and containers and on guard forces accompanying shipments. (GRA)

39359 (PB—256963) **Report to the Congress on the need for, and the feasibility of, establishing a security agency within the Office of Nuclear Material Safety and Safeguards. Executive summary.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Nuclear Material Safety and Safeguards). Aug 1976. 28p. (NUREG—0015-ES). NTIS $4.00.

Report on Security Agency Study. See also PB—256962.

The Executive Summary of a report written in response to the Congressional mandate Section 204(b)-(2) (c) of the Energy Reorganization Act of 1974, by the Director of the Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission (NRC) is given. It summarizes the main report, which assessed guard force effectiveness, and addressed public policy, administration and legal issues. (GRA)

39360 Gamma-ray perimeter security system. Close, D.A. (Los Alamos Scientific Lab., NM). *Nucl. Technol.;* **32**: No. 2, 205-210(Feb 1977).

A prototype perimeter security system using a beam of gamma rays from ^{137}Cs is extremely sensitive to interruptions of the beam. Monte Carlo calculations indicate that a 1-Ci source is adequate to protect an interval of 93 m. A gamma-ray source can easily be made bidirectional, which would allow approximately 200 m of perimeter to be guarded. A system using a gamma ray having an energy in the range of 500 to 1000 keV would result in a minimum number of false alarms per year.

FUSION FUELS

REFER ALSO TO CITATION(S) 39663

SOURCES

39361 Scaling law for ablation of a hydrogen pellet in a plasma. Vaslow, D.F. (General Atomic Co., San Diego, CA). *IEEE Trans. Plasma Sci.;* **PS-5**: No. 1, 12-17(Mar 1977).

A scaling law is derived which gives the rate of ablation of a frozen hydrogen pellet immersed in a plasma without the presence of a magnetic field or space charge. Plasma particles penetrate the ablating gas—plasma cloud to the evaporating pellet surface and deliver power to the cloud to drive its expansion. The evaporation rate is determined by a "self-regulating" mechanism. The ablation time is shown to be proportional to a /sup $^5/_3$/lambda$_0$—/sup $^3/_3$/ GAMMA$_0$—/sup $^1/_3$/ where a is the pellet radius, lambda$_0$ is the effective penetration depth of the incident particle into solid hydrogen and GAMMA$_0$ is the power flux density of the incident particles. It is found that for ablation in a thermonuclear plasma, the alpha particles significantly affect the ablation rate. For thermonuclear plasma electrons and alpha particles, the energy required to ablate one molecule is shown to be of the order of 10 eV or less. The scaling law is applied to presently available experimental results, and reasonable agreement is found.

PROCESSING

REFER ALSO TO CITATION(S) 40682

39362 Method and means for producing solid evacuated microspheres of hydrogen. Turnbull, R.J.; Foster, C.A.; Hendricks, C.D. (to Energy Research and Development Administration). US Patent 3,985,841. 12 Oct 1976. Filed date 6 Nov 1975. 4p.

PAT-APPL-629,244.

A method is provided for producing solid, evacuated microspheres comprised of hydrogen. The spheres are produced by forming a jet of liquid hydrogen and exciting mechanical waves on the jet of appropriate frequency so that the jet breaks up into drops with a bubble formed in each drop by cavitation. The drops are exposed to a pressure less than the vapor pressure of the liquid hydrogen so that the bubble which is formed within each drop expands. The drops which contain bubbles are exposed to an environment having a pressure just below the triple point of liquid hydrogen and they hereby freeze giving solid, evacuated spheres of hydrogen. 4 claims, 1 fig.

39363 Method for selecting hollow microspheres for use in laser fusion targets. Farnum, E.H.; Fries, R.J.; Havenhill, J.W.; Smith, M.L.; Stoltz, D.L. (to Energy Research and Development Administration). US Patent 3,997,435. 14 Dec 1976. Filed date 29 Oct 1975. 8p.

PAT-APPL-626,953.

Hollow microspheres having thin and very uniform wall thickness are useful as containers for the deuterium and tritium gas mixture used as a fuel in laser fusion targets. Hollow microspheres are commercially available; however, in commercial lots only a very small number meet the rigid requirements for use in laser fusion targets. Those meeting these requirements may be separated from the unsuitable ones by subjecting the commercial lot to size and density separations and then by subjecting those hollow microspheres thus separated to an external pressurization at which those which are aspherical or which have nonuniform walls are broken and separating the sound hollow microspheres from the broken ones. 8 claims, 6 figures.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

PHYSICAL ISOTOPE SEPARATION

HEAVY WATER PRODUCTION

39364 Separation of isotopes by cyclical processes. Hamrin, C.E. Jr.; Weaver, K. (to Energy Research and Development Administration). US Patent 3,989,484. 2 Nov 1976. Filed date 11 Mar 1975. 10p.

PAT-APPL-557-566.

Various isotopes of hydrogen are separated by a cyclic sorption process in which a gas stream containing the isotopes is periodically passed through a high pressure column containing a palladium sorbent. A portion of the product from the high pressure column is passed through a second column at lower pressure to act as a purge. Before the sorbent in the high pressure column becomes saturated, the sequence is reversed with the stream flowing through the former low-pressure column now at high pressure, and a portion of the product purging the former high pressure column now at low pressure. The sequence is continued in cyclic manner with the product being enriched in a particular isotope.

RADIATION SOURCES

REFER ALSO TO CITATION(S) 40095

DESIGN AND FABRICATION

REFER ALSO TO CITATION(S) 40619

OTHER INDUSTRIAL USES

REFER ALSO TO CITATION(S) 40586

ISOTOPIC POWER SUPPLIES

39365 (LA—6534) **Reduction of PuO_2 by CO and equilibrium partial pressures above plutonia.** Kent, R.A.; Zocher, R.W. (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1976. Contract W-7405-ENG-36. 27p. P 03/MF A01.

The reduction of plutonia in flowing carbon monoxide has been determined over the range of 1200 to 1800°K. The experimental data confirm recently published thermodynamic functions for the plutonium—oxygen system. Equilibrium partial pressures are listed for vapor species above stoichiometric and reduced plutonia in the range 1200 to 1800°K.

DESIGN AND FABRICATION

39366 **Process for making a deep diode atomic battery.** Anthony, T.R.; Cline, H.E. (to General Electric Co.). US Patent 4,010,534. 8 Mar 1977. Filed date 27 Jun 1975. 18p.

The process for making a deep diode atomic battery embodies thermal gradient zone melting techniques for fabricating the structure thereof. Thermal gradient zone melting may also be employed to provide the battery with a radioactive source for energizing the battery.

USES

39367 (PB—257888) **Implanted energy conversion system. Annual report, 1 May 1975—1 Jun 1976.** Johnston, R.P.; Bakker, L.P.; Bennett, A.; Blair, C.R.; Emigh, S.G. (McDonnell Douglas Astronautics Co., Richland, Wash. (USA). Richland Energy Lab.). Aug 1976. Contract N01-HV-4-2901. 255p. (MDC-G—4448). NTIS $9.00.

See annual rept. dated Aug 1975, PB—245088.

The Richland Energy Laboratory heart power source combines the high efficiency of Stirling engines with the reliability, efficiency, and flexibility of hydraulic power transfer and control to ensure long system life and physiological effectiveness. Extended life testing has already been achieved with an engine (1.57 years) and hydraulic actuator/controller (1.07 years) in continuing tests without failure. Animal in-vivo tests with an assist heart have consistently demonstrated required performance by biological synchronization and effective ventricle relief. Carefully planned development of System 6 has produced major reductions in required input power and size. Peak power source efficiency is 15.5 (+0.2, -0.3)% on 5.10 (+.07, -.09) watts delivered to the blood pump push plate with 33 watts steady thermal input. Volume and weight are 0.93 liter and 2.4 kg (excluding blood pump) with an additional 0.4 liter of low temperature foam insulation required to preclude tissue thermal damage. (GRA)

39368 **Vacuum foil insulation system.** Hanson, J.P.; Sabolcik, R.E.; Svedberg, R.C. (to Energy Research and Development Administration). US Patent 3,991,898. 16 Nov 1976. Filed date 16 Sep 1975. 4p.

PAT-APPL-613,780.

In a multifoil thermal insulation package having a plurality of concentric cylindrical cups, means are provided for reducing heat loss from the penetration region which extends through the cups. At least one cup includes an integral skirt extending from one end of the cup to intersection with the penetration means. Assembly of the insulation package with the skirted cup is facilitated by splitting the cup to allow it to be opened up and fitted around the other cups during assembly. The insulation is for an implantable nuclear powered artificial heart.

HYDROGEN

PRODUCTION

REFER ALSO TO CITATION(S) 39071, 39381

39369 **Apparatus useful for the production of hydrogen.** Barber, E.M. (to Texaco Inc.). US Patent 4,007,015. 8 Feb 1977. Filed date 17 Dec 1975. 12p.

Hydrogen is produced by the combustion of carbon with air to produce a combustion gas effluent containing carbon dioxide and nitrogen. The carbon dioxide is separated and reacted with carbon to produce carbon monoxide. The resulting produced carbon monoxide is then reacted with steam to produce carbon dioxide and hydrogen and the resulting produced hydrogen is separated. The carbon utilized for the production of hydrogen may be obtained by the thermal decomposition of hydrocarbons to yield carbon and gaseous hydrogen or the carbon utilized in this process may be obtained from a solid carbonaceous fuel, such as coal or coke or the like. A reactor useful for the thermal decomposition of a hydrocarbonaceous fuel to produce gaseous hydrogen and carbon and particularly adaptable for use in the process in accordance with this invention comprises a reactor provided with a high temperature thermal decomposition zone and means therein for effecting the separation between any solid ash constituents of the fuel, the resulting produced carbon and the resulting produced gaseous hydrogen.

THERMOCHEMICAL PROCESSES

39370 **Thermochemical production of hydrogen.** Dreyfuss, R.M. (to Energy Research and Development Administration). US Patent 3,969,495. 13 Jul 1976. Filed date 26 Jun 1975. 6p.

PAT-APPL-590,749.

A thermochemical reaction cycle for the generation of hydrogen from water is claimed comprising the following sequence of reactions where M represents a metal and Z represents a metalloid selected from the arsenic-antimony-bismuth and selenium-tellurium subgroups of the periodic system: $2MO + Z + SO_2$ yields $MZ + MSO_4$; $MZ + H_2SO_4$ yields $MSO_4 + H_2Z$; $2MSO_4$ yields $2MO + SO_2 + SO_3 + 1/2O_2$; H_2Z yields $Z + H_2$; $H_2O + SO_3$ yields H_2SO_4. The net reaction is the decomposition of water into hydrogen and oxygen.

39371 **Process for the preparation of hydrogen.** duPont, A.A. US Patent 4,010,249. 1 Mar 1977. Filed date 15 Sep 1977. 6p.

Hydrogen is produced from water by the addition of heat to a series of chemical reactions which comprise the reaction of cadmium with water, and the subsequent recovery of the cadmium for re-use. The equipment used to produce the hydrogen requires only the input of water and heat to produce an output of hydrogen and oxygen gas.

39372 **Process for obtaining hydrogen and oxygen from water using iron and chlorine.** Schulten, R. (to Rheinische Braunkohlenwerke AG). US Patent 4,013,781. 22 Mar 1977. Priority date 4 Jul 1973, German, Federal Republic of (F.R. Germany). 6p.

Hydrogen and oxygen are obtained from water using a multistep circulatory process using iron compounds and chlorine as adjuvants. Using three beds, respectively containing magnesium chloride, iron oxide and cuprous chloride, and by a four-step process involving passing steam through the magnesium bed, carbon monoxide through the iron bed, carbon dioxide through the copper bed, and steam through the iron bed, one obtains hydrogen and oxygen as end products and is left with the starting materials in the respective beds. An efficiency of about 60 percent can be achieved by the process.

STEAM REFORMER PROCESSES

REFER ALSO TO CITATION(S) 39718

39373 **Method for producing synthetic fuels from solid waste.** Antal, M.J. Jr. (to Energy Research and Development Administration). US Patent 3,993,458. 23 Nov 1976. Filed date 28 Mar 1975. 8p.

PAT-APPL-563,274.

Organic solid wastes represented by the general chemical formula C/sub X/H/sub Y/O/sub Z/ are reacted with steam at elevated temperatures to produce H_2 and CO_2. The reaction is endothermic and requires heat. This heat is supplied by a tower top solar furnace; alternatively, some of the solid wastes can be burned to supply heat for the reaction. The hydrogen produced can be used as a fuel or a chemical feedstock. Alternatively, methanol can be produced. Since the reaction is endothermic, the system represents a method for storing heat energy from an external source in a chemical fuel produced from solid wastes. 6 claims, 1 figure.

STORAGE

CHEMISORPTION

39374 **Hydrogen storage method by metal hydrides, 1.** Fukuda, Y.; Fujimura, T. (Japan Defence Agency, Tokyo). *Giho (Boeicho Gijutsu Kenkyu Honbu);* No. 644, 1-12(Jul 1975). (In Japanese).

Vanadium hydride containing 1.19% titanium was prepared by the direct reaction of hydrogen with the metal. The reaction was reversible and upon decomposition the original starting material was regenerated. Several pressure - composition isotherms were determined for the system VHsub(0.9)-VHsub(1.9), The dissociation pressure of the hydride was found to obey the relationship log P sub(atm)=(-5065/T)+17.5 from which thermodynamic values was calculated. Of the impurities, titanium was particularly efficacious. Vanadium hydride containing 8.22% titanium could contain about 430 ml (N.T.P) hydrogen per gram metal, but the hydride had lower dissociation pressure than one atmosphere at room temperature.

INDUSTRIAL AND COMMERCIAL USE

REFER ALSO TO CITATION(S) 39833

PROPERTIES

REFER ALSO TO CITATION(S) 39943

OTHER SYNTHETIC AND NATURAL FUELS

HYDROCARBON FUELS

39375 (MERC/CR—77/4(Vol.1)) **Systems studies of energy conservation: methane produced from coalbeds.** (TRW Systems Group, McLean, Va. (USA)). Jan 1977. Contract E(46-1)-8042. 164p. P 08/MF A01.

Utilization of coalbed methane gas is practicable and economically favorable. Drainage of methane in advance of mining, and from gob areas subsequent to mining, decreases the quantity of methane now being released into the mine environment. Such drainage reduces ventilation requirements and the hazards of removing methane by this technique. Therefore, a severe hazard is significantly reduced, greatly enhancing underground mine safety. Differences in type of mining in progress, site access, availability of commercial gas transmission pipelines, ownership of surface rights and gas rights, legal constraints, etc., require several different techniques for gas recovery and several variant uses for the recovered methane gas. Cost-sharing of demonstration projects between government and private interests is necessary to expedite early commercial applications and encourage conservation of this resource. Legal problems and possible litigation may result when coalbed methane gas is recovered and utilized in a profitable venture. Coal rights agreements vary in mining ventures, and when they do not specifically state or imply the right to recover gas released in conjunction with mining requirements, litigation to recover royalties likely to result.

39376 (MERC/CR—77/4(Vol.2)) **Systems studies of energy conservation: methane produced from coalbeds.** (TRW Systems Group, McLean, Va. (USA)). Jan 1977. Contract E(46-1)-8042. 110p. P 06/MF A01.

This volume consists of ll appendices entitled: Coal Reserves; Coal Analysis; Companies Possessing Coal Mining Rights in the Pittsburgh Coalbed; Currently Active Underground Mines in the Pittsburgh Coalbed; Mine and Pipeline Maps of Northern Appalachian Basin; Composition of Gob Coal Gas from Pittsburgh Coalbed Mines; Topographic Maps with Woodland Overprints; Environmental Regulations for Industrial Process Wastes; Questionnaire on Mining and Drainage Practices Circulated to the Mining Industry; Projected Well Performance and Well Spacing Requirements; and Methane Recovery Investment Analysis. (EJH)

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 39079, 39087

39377 **Thermodynamics of the hydrogenation of oxides of carbon.** Anderson, R.B.; Lee, C.B.; Machiels, J.C. (McMaster Univ., Hamilton, Ont.). *Can. J. Chem. Eng.;* **54**: No. 6, 590-594(Dec 1976).

The thermodynamics of the hydrogenation of CO and CO_2 is summarized. Equilibrium compositions for a number of reactions proceeding simultaneously to yield a number of hydrocarbons and oxygenated organic molecules are reported. If methane is included in these calculations, methane is the predominant product; therefore, for the production of other molecules selective catalysts are required. For producing methane the hydrogenation of CO_2 rather than CO may be advantageous, because the reaction is less exothermic. Thermodynamic calculations and results of tests on Raney nickel in a small tubular reactor show that high yields of methane can be obtained in the hydrogenation of both CO and CO_2 at temperatures as high as 450°C. 6 tables.

39378 **Substituted natural gas via hydrocarbon steam reforming.** Jo, H.K. (to UOP Inc.). US Patent 4,010,008. 1 Mar 1977. Filed date 1 Mar 1977. 12p.

A multiple-stage hydrocarbon steam reforming process for producing a methane-rich substitute natural gas is claimed. A portion of the first stage effluent is condensed, water is removed therefrom and the remainder is recycled to combine with the fresh charge stock to the first stage. Following one stage of methanation, or shift conversion, both steam and carbon dioxide are removed prior to effecting additional reactions in a second methanation stage. 7 claims, 1 figure.

39379 **Conversion of methanol to gasoline with minimum durene production.** Chang, C.D.; Lang, W.H. (to Mobil Oil Corp.). US Patent 4,013,732. 22 Mar 1977. Filed date 17 Oct 1975. 8p.

The conversion of methanol to gasoline boiling hydrocarbons of low durene content is accomplished with a ZSM5 crystalline zeolite alone or supported by a binder-matrix material comprising primarily materials other than alumina. 6 claims.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 39076, 39713, 39756

39380 (FE—2469-3) **Experimental program for the development of peat gasification. Interim report No. 1, February 10—June 30, 1976.** (Institute of Gas Technology, Chicago, Ill. (USA)). 1976. Contract E(49-18)-2469. 21p. Dep. NTIS $3.50.

Although peat is a geologically young coal, its physical structure and chemical composition are significantly different from those of coal. Unlike coal, peat is a fibrous material and contains higher moisture, volatile matter, and oxygen contents than coal. Various samples of peat from the same vicinity showed considerable variation in ash content. However, on an MAF basis, the variation in peat composition was very small. The results also show that drying and grinding of peat decreases its liquid-absorption capacity of peat for five potential slurry media show that toluene was the least absorbed (35.9 weight percent), followed by acetone (37.8 weight percent), propanol (45.2 weight percent), ethanol (50.5 weight percent), and water (60.7 weight percent). The results also show that the total liquid absorbed by peat is only slightly less when it is first soaked briefly in water and then in toluene than in the reverse order. Slurriability tests conducted with -10 mesh peat show that about 67 weight percent toluene (2:1 ratio of toluene/peat) is required to make a pumpable slurry. Preliminary results of the thermobalance tests, conducted to determine the characteristics of peat gasification in hydrogen, show that initial devolatilization in nitrogen slows the subsequent gasification in hydrogen. However, such a decrease in reactivity is much less than it is for coal.

39381 **Decomposition of carbohydrate wastes.** Appell, H.R.; Pantages, P. (to Energy Research and Development Administration). US Patent 3,989,480. 2 Nov 1976. Filed date 25 Mar 1976. 4p. PAT-APPL-670,479.

Carbohydrate waste materials are decomposed to form a gaseous fuel product by contacting them with a transition metal catalyst at elevated temperature substantially in the absence of water. 8 claims.

ALCOHOL FUELS

REFER ALSO TO CITATION(S) 39837

39382 (NP—21727) **Methanol: its synthesis, use as a fuel, economics, and hazards.** Hagen, D.L. (Minnesota Univ., Minneapolis (USA); Energy Research and Development Administration, Washington, D.C. (USA)). Dec 1976. vp. Q 09/MF A01.

Thesis.

The synthesis of methanol using existing and proposed means of production and sources of feedstocks is reviewed. Conventional methods of producing methanol are surveyed. Proposed methods of fermentation, electro-, and radiation-synthesis are discussed. Conventional production technology from synthesis gas is examined in detail. The range of possible sources of feedstocks from fossil fuels to biomass, atmospheric carbon dioxide, and carbonates are portrayed along with renewable and nonrenewable energy sources. A survey of recent studies and research on methanol is given within the historical context. Fuel related properties are reviewed and compared with isooctane. Combustion emissions and their variation with

temperature and fuel preparation are similarly compared. Uses of methanol as a combustion fuel and recent tests in boilers, turbines, conventional and stratified charge Otto engines, and diesel engines are discussed emphasizing comparative efficiencies. Current developments on the uses of methanol directly and indirectly in fuel cells and as a feedstock for single cell protein are examined. Historical prices of methanol are presented along with major causes for the fluctuations. The costs of synthesizing methanol are presented including overall production costs from organic feedstocks. Proposed costs of producing methanol from electrolytic hydrogen and carbon dioxide are also given. Fiscal and physical causes for inflation are discussed along with the costs of storage, transportation and conversion. The numerous biological, physical, and chemical hazards of using methanol as a fuel are discussed together with safety precautions and treatment. 609 references.

PROPERTIES

39383 (BERC/RI—76/12) **Physical properties of gasoline/methanol mixtures.** Eccleston, B.H.; Cox, F.W. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Jan 1977. 84p. P 05/MF A01.

Experimental work was done to relate selected physical properties of gasoline/methanol solutions, containing contaminant levels of water, to compositional and physical properties of the blending gasoline. Water tolerance, octane number, vapor pressure, and distillation data are presented for eight gasolines and for their methanol solutions at methanol levels up to 20 wt-pct. The water tolerances of these fuels were strongly dependent upon temperature, methanol concentration, and gasoline composition. To cover a wider range of compositional effects, water tolerance measurements were made at selected methanol levels on a variety of individual hydrocarbons, refinery stocks, and gasolines selected for specific compositional characteristics. These selections provided a sufficient range of property variation for the data to permit useful water-tolerance/gasoline composition correlations. The results presented in this report supplement and expand published data on water tolerances of gasoline/methanol mixtures. It is shown that an estimate can be made of the water tolerance of a gasoline/methanol mixture when the composition of the gasoline is known in sufficient detail. Portions of the D-86 distillation curves of gasoline/methanol mixtures can be estimated from a knowledge of the base gasoline distillation curves. In the region of 5 to 20 pct methanol content, vapor pressures can be estimated from those of the gasolines. The blending octane numbers resulting from the study agree well with previously published values. The referenced material and their associated bibliographies are intended to serve as a source of information regarding previous work on methanol and methanol/gasoline solutions for use as automotive fuel.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 39373, 39757

PROPERTIES

39384 Catalytic decomposition of hydrogen peroxide in an alkaline medium. VI. The decomposition process on copper-activated carbon black. Legenchenko, I.A.; Semizorova, N.F. (Odessa State Univ.). *Russ. J. Phys. Chem. (Engl. Transl.);* **50**: No. 2, 229-231(Feb 1976).

Translated from Zh. Fiz. Khim.; 50: 391-393(1976).

The rate of reaction varies linearly with the content of activator in the carbon black. New data have been obtained showing the independence of the potential-generating process on the bulk of the catalyst surface and the decomposition of the peroxide on its active regions.

39385 Catalytic decomposition of hydrogen peroxide in an alkaline medium. IV. Kinetics of the process on carbon black. Legenchenko, I.A.; Semizorova, N.F. (Odessa State Univ.). *Russ. J. Phys. Chem. (Engl. Transl.);* **50**: No. 3, 386-388(Mar 1976).

Translated from Zh. Fiz. Khim.; 51: 660-662(1976).

The view put forward in previous reports that the process occurring mainly on electron-accepting sections of the surface has a chain mechanism has been confirmed.

39386 Decomposition of hydrogen peroxide in the presence of tetranitromethane catalysed by iron(III) ions. Determination of the rate constant for the chain propagation reaction. Nadezhdin, A.D.; Kozlov, Yu.N.; Purmal, A.P. (Inst. of Chemical Physics, Moscow). *Russ. J. Phys. Chem. (Engl. Transl.);* **50**: No. 4, 542-543(Apr 1976).

Translated from Zh. Fiz. Khim.; 50: 910-912(1976).

The kinetics of the catalytic decomposition of H_2O_2 by Fe^{3+} ions in the presence of tetranitromethane have been investigated and the ratio of the rate constants for the interaction of the O^-_2 radical-ion with Fe^{3+} and $C(NO_2)_4$ has been determined.

39387 Activity of iridium—ruthenium and iridium—rhodium adsorption catalysts in the decomposition of hydrogen peroxide. Zubovich, I.A.; Mikhailov, V.A.; Migulina, N.N. (Yaroslavl Polytechnic Inst., USSR). *Russ. J. Phys. Chem. (Engl. Transl.);* **50**: No. 6, 900-901(Jun 1976).

Translated from Zh. Fiz. Khim.; 50: 1492-1494(1976).

Experimental data for the activities of iridium—ruthenium and iridium—rhodium adsorption catalysts in the decomposition of hydrogen peroxide are considered and the results of magnetic susceptibility measurements are presented. It is concluded that surface structures (complexes) may be formed and that microelectronic features play a role in heterogeneous catalysis.

PREPARATION

REFER ALSO TO CITATION(S) 39057

39388 Synthesis of hydrogen peroxide by oxidation of isopropyl alcohol. Pneva, E.Ya. *Sov. Chem. Ind. (Engl. Transl.);* **8**: No. 9, 692-693(Sep 1976).

Tranlated from Khim. Prom.; 8: No. 9, 659-660(1976).

The article describes a new method for producing hydrogen peroxide based on liquid phase oxidation of isopropyl alcohol with molecular oxygen. The engineering system of the process is described.

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 39713, 39758, 39759, 40066

LIQUID WASTE FUELS

REFER ALSO TO CITATION(S) 40189

39389 Utilization of rejected petroleum products and waste products as fuel. Baluev, E.D. (Gor'kii Eng Constr Inst im. V.P. Chkalov, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 8, 133-136(Aug 1976). (In Russian).

Recommendations are given on the utilization of rejected petroleum products and waste products as fuel for boilers at industrial enterprises.

HYDRO ENERGY

REFER ALSO TO CITATION(S) 39427, 39666

39390 Hydro projects provide thrust for Manitoba engineering. *Eng. J. (Montreal);* **60**: No. 2, 31(1977).

The impact of hydroelectric power projects on engineering employment in Manitoba, Canada is discussed. The engineering sector is not suffering as much as other sectors of the economy. (LCL)

RESOURCES AND AVAILABILITY

39391 Water story. Gihel, F. *Rev. Energ.;* **27**: No. 285, 353-356(Jul-Aug 1976). (In French).

Consequences of the drought which afflicted Western Europe in the summer of 1976 are analyzed. In particular the shortages of water for electricity generation by hydroelectric power plants in France are pointed out giving the appropriate figures. The measures taken to avoid disruption of power supply to the customers are surveyed.

PLANT DESIGN AND OPERATION

39392 (PB—259722) **Selecting hydraulic reaction turbines.** Walters, R.N.; Bates, C.G. (Bureau of Reclamation, Denver, Colo. (USA). Engineering and Research Center). Oct 1976. 57p. Q 04/MF A01.

Modern trends in the selection of hydraulic reaction turbines are described. Figures are included which show characteristics of

the turbine in relation to various parameters for estimating size and predicting performance of the unit.

39393 Soviet hydroelectric power generation in the tenth five-year plan period. Shchavelev, D.S.; Erlikhman, B.L. (Leningrad Polytech Inst im. M.I. Kalinin, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 8, 103-108(Aug 1976). (In Russian).

A brief survey of the plans of construction of hydroelectric power plants in different major regions of the USSR is presented.

39394 Taking account of the time factor in determining multipurpose efficiency of hydroelectric power projects. Semenov, M.V. (Leningrad Polytech Inst im. M.I. Kalinin, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 9, 90-93(Sep 1976). (In Russian).

Conditions of application of the criterion of multipurpose efficiency in justifying hydroelectric power projects are considered. The requirement to take into account the dynamic of the properties of a hydroelectric power project and of an alternative one in time is substantiated. A formula is proposed for the dynamic criterion of multipurpose efficiency.

39395 Establishment of welding procedures for super thick 80 kg/mm² class forged steel used for penstocks. Fujishiro, Y.; Gotoh, T.; Taniguchi, T.; Iizuka, T.; Tajitsu, O.; Akiyama, K. *Kawasaki Giho;* No. 62, 323-329(Dec 1976). (In Japanese).

Recently, in Japan, numerous large scale pump-up hydroelectric stations have been constructed. Penstocks to be applied to these stations have become gigantic; 80 kg/mm² class up to 350 mm thickness forged steel is required for reinforcement rings of their spherical branches and for flanges at their ends. After confirmation of the properties of the base metal and joints by MIG welding and submerged arc welding for 80 kg/mm² class forged steel, the steel has been successfully applied to Okukiyotsu pump-up power station penstocks.

LAND USE AND AESTHETICS

REFER ALSO TO CITATION(S) 39659

SOLAR ENERGY

REFER ALSO TO CITATION(S) 39663

39396 Economic aspects of solar energy: selective and critical bibliography. Cavard, D.; Criqui, P. *Rev. Energ.;* 27: No. 288, 533-540(Nov 1976). (In French).

A selection of works on solar energy is reviewed. They have been assembled in the framework of a research on the possibilities of penetration of solar energy into the energy balance in France and in underdeveloped countries. First different types of documents, such as general works, papers and proceedings of conferences and seminars, and journals, are surveyed. Then, documents dealing with a specific technology or type of utilization of solar energy are discussed. They are grouped as follows: utilization of solar energy in the habitat, photovoltaic conversion of solar energy, utilization of thermal properties of solar energy by thermodynamic processes, technologies applied to the developement, institutional and legal aspects, research and development, meteorological data.

RESOURCES AND AVAILABILITY

39397 (ERDA/JPL/954328—76/5) **Terrestrial service environments for selected geographic locations. Final report.** Thomas, R.E.; Carmichael, D.C. (Battelle Columbus Labs., Ohio (USA)). 24 Jun 1976. Contract NAS-7-100-954328. 224p. P 10/MF A01.

This report contains results obtained from analyses of climatic, precipitation, air pollution, and other environmental data for the years 1965 to 1974 at nine widely different geographic locations in the United States (Albuquerque, N.M.; Bismarck, N.D.; Boston, Mass.; Brownsville, TX.; Cleveland, OH; Fairbanks, AK; Los Angeles, CA; Miami, FL; and Phoenix, AZ). In addition to descriptive and diurnal statistics for 24 individual climatic variables, "environmental cell" statistics were computed to obtain the frequencies, durations, and transitions for the simultaneous occurrence of various combinations of environmental variables. Results are presented for the simultaneous occurrence of specific levels of air temperature, relative humidity, wind speed, and insolation, in addition to representative results obtained for other combinations of variables. The results characterize the environmental conditions to which terrestrial solar arrays would be exposed over a 20-year lifetime, and serve to identify environmental factors and levels that can be used in testing candidate encapsulation materials and systems for such terrestrial exposures. An innovative methodology was applied to obtain these results for combinations of environmental variables. Because of its generality and demonstrated feasibility, it is concluded that the methodology also has broad applications to other testing programs.

39398 (SAND—77-0004) **Solar radiation availability for New Mexico.** Boes, E.C. (Sandia Labs., Albuquerque, N.Mex. (USA)). Feb 1977. Contract EY-76-C-04-0789. 18p. P 02/MF A01.

In order to design a solar system or to make a prediction regarding its performance, one needs to know the amount of solar energy which will be available to the system. An elementary description is given of the basic geometric considerations and background information on solar radiation availability. In addition, tables giving both average and clear day solar energy availabilities in the four seasons are presented. The solar energy available to a collector depends on the collector type and its orientation. The availabilities are presented for a wide variety of possible surface orientations, including orientations for focusing collectors, tracking collectors, and fixed collectors.

39399 (PB—255819) **Calculated actinic fluxes (290 - 700 nm) for air pollution photochemistry applications.** Peterson, J.T. (Environmental Sciences Research Lab., Research Triangle Park, N.C. (USA). Meteorology and Assessment Div.). Jun 1976. 63p. (EPA—600/4-76/025). NTIS $4.50.

Calculations are presented of the actinic (spherically integrated) solar flux from 290 to 700 nm at solar zenith angles between 0 and 86 degrees. The calculated values are obtained by using a radiative transfer program (developed by Dave) that accounts for molecular scattering, ozone absorption, and aerosol scattering and absorption. Input data consists of aerosol size distribution, aerosol number and ozone concentrations as a function of height, aerosol index of refraction, and the following as a function of wavelength: ozone absorption coefficient, molecular scattering coefficient, solar constant, and surface reflectivity. The calculated actinic flux values are evaluated for their dependence on variations of surface reflectivity, aerosol amount, ozone amount and station elevation. The variation of the actinic flux with altitude above the surface is discussed with emphasis on the change through the lowest kilometer of the atmosphere. Finally, the flux values presented here are compared to those of Leighton (1961); the differences in the methodology and input data between the two studies are illustrated. These calculated actinic flux data are useful for estimating photodissociation rate constants for application to photochemical air pollution problems. (GRA)

ECONOMICS

REFER ALSO TO CITATION(S) 39483

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 39399, 39451, 40372

39400 (LBL—5927) **Ecological considerations of the solar alternative.** Davidson, M.; Grether, D.; Wilcox, K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1977. Contract W-7405-ENG-48. 48p. P 02/MF A01.

The main solar technologies are considered including solar thermal power, photovoltaic cells, ocean thermal power, wind energy, solar heating and cooling, bioconversion, and agricultural and process heat. The direct and indirect ecological and environmental impacts of these technologies are discussed. (WHK)

SOLAR ENERGY CONVERSION

REFER ALSO TO CITATION(S) 39987

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 39397

39401 (ERDA/JPL/954344—76/4) **Web-dendritic ribbon growth. Quarterly report, October 1976—December 15, 1976.** Hilborn, R.B. Jr.; Faust, J.W. Jr. (South Carolina Univ., Columbia (USA). Coll. of Engineering). 28 Dec 1976. Contract NAS-7-100-954344. 35p. Dep. NTIS $4.00.

A report of the fifth quarter's work on the web-dendritic ribbon growth at the University of South Carolina is presented. A brief description of the work initiated and carried out during this period to meet the program goals is given along with a copy of the Program Plan covering the entire period of the contract. The web growth portion of this program was spent in the design, installation and testing of a new furnace geometry for the growth of dendritic

web ribbon. The new installation was completed and the testing 90% accomplished. Results of the testing to determine the effect of the relative position of the r.f. coil with respect to the susceptor on the thermal profile in the melt are described. The one-dimensional thermal model has been used to determine the relationship between growth rate, web thickness, and mensicus height for stable growth. The results of this analysis are also given. An analysis was completed of the thermal radiation from the meniscus including the effect of the curvature of the meniscus with the results indicating that inclusion of the curvature leads to approximately a 10% increase in the radiation loss.

39402 (ERDA/JPL/954350—76/4) **Large area silicon sheet task low-cost silicon solar array project. Fourth quarterly progress report, September 27, 1976—December 31, 1976.** Garfinkel, M.; Hall, R.N. (General Electric Co., Schenectady, N.Y. (USA)). 7 Jan 1977. Contract NAS-7-100-954350. 21p. P 02/MF A01.

The seeded growth furnace with a slotted molybdenum susceptor has been operated during the past quarter. The susceptor design permits flat sheets of refractory materials to be used in making up the tray. Fused quartz and sapphire trays were used. Local surface cooling was obtained by means of a water-cooled cold finger. Seeded surface growth has been obtained in this furnace using a seed with [111] axis and (112) principal faces. The silicon grown out of solution has a region approximately 3 mm x 5 mm, which is substantially single-crystal with the same crystallographic orientation as the seed. Sessile drop experiments have been initiated as a rapid method of determining the suitability of various refractory materials as trays for tin melts. These experiments indicate the presence of some impurity in the starting tin, which forms a surface film that prevents the tin from wetting silicon. This film can be removed by heating the tin to 900°C in hydrogen.

39403 (ERDA/JPL/954356—76/4) **Dip coating process. Silicon sheet growth development for the large-area silicon sheet task of the low-cost silicon solar array project. Quarterly report No. 4, September 17, 1976—December 17, 1976.** Heaps, J.D.; Zook, J.D.; Maciolek, R.B.; Schuldt, S.; Schuller, T.L.; Nelson, L.D.; Peterson, A.A.; Knudsen, C.I. (Honeywell Corporate Research Center, Bloomington, Minn. (USA)). 28 Dec 1976. Contract NAS-7-100-954356. 70p. Dep. NTIS $4.50.

The objective of this research program is to investigate the technical and economic feasibility of producing solar cell-quality sheet silicon by coating one surface of carbonized ceramic substrates with a thin layer of large-grain polycrystalline silicon from the melt. With the present dip coating facility, pulling rates of 5 to 7 cm/min are most likely to produce layers of the crystalline quality from which high efficiency solar cells can be fabricated. At a pulling rate of 5 cm/min, it is possible to achieve smooth 50-μm thick layers, with grains as large as 2.5-mm wide, generally extending the entire length of the substrate. At pulling rates less than 6 cm/min, single grains as large as 4 mm in width have been observed. Substrates held at an angle of 45° to the surface of the melt during dipping produced layers qualitatively similar to the vertical dipped layers, but they show some potential for improved coating uniformity. Diffractometer measurements on several samples showed that the strongest diffraction peak was from the silicon 220 plane which is about 10° from the sample surface. The (110) surfaces have been found to be dominant in the EFG and dendritic material, and it appears this is a general characteristic of sheet-grown silicon. Mullite substrates containing an excess of SiO_2 have been shown to match the thermal expansion coefficient of silicon. Mullite, however,dissolves slightly in the silicon melt, adding aluminum impurities to the silicon layers. A preliminary Ion Beam Microprobe analysis revealed that the aluminum concentration measured in three samples of typical dip-coated silicon layers correlated correctly with the measured restitivies. Photodiodes were made on a number of silicon on ceramic (SOC) layers, and results of performance tests are discussed.

39404 (ERDA/JPL/954560—76/2) **Synthesis of silane and silicon in a non-equilibrium plasma jet. Second quarterly report, September 21—December 20, 1976.** Calcote, H.F.; Felder, W. (Aerochem Research Labs., Inc., Princeton, N.J. (USA)). Dec 1976. Contract NAS-7-100-954560. 30p. (Aero-Chem(TN)—169). Dep. NTIS $4.00.

The objective of this program is to determine the feasibility of high volume, low-cost production of high purity silane or solar grade silicon using a non-equilibrium hydrogen plasma jet. Reactions of hydrogen atoms produced in the plasma jet with chlorosilanes (added either to the discharge or to the hydrogen atom stream) are being studied. During this quarter, hydrogen atom production in the plasma jet (the sine qua non for carrying out the chemical experiments) has been investigated with 3.5 and 6.1 mm diam nozzles both as anodes and as cathodes for the glow discharge. Complete energy balance data for the discharges have been obtained at H_2 pressures of 25, 50, and 225 Torr with emphasis on the 50 Torr data. Results were sufficiently encouraging (e.g., 2.7% (vol) H atom concentrations were obtained at 30% energy conversion into H atoms) that chemical synthesis studies were begun. $SiCl_4$ was initially added to the discharge with H_2 and metallic deposits were formed in the discharge region. Downstream, a brown powder was formed on the reactor walls. In further work, $SiCl_4$ was added to the H/H_2 jet. A reaction ensued, depositing a brown powder on the reactor walls. Qualitative analytical tests of this powder are consistent with its being amorphous Si. The $H/H_2/SiCl_4$ reaction results in a green chemiluminescence.

39405 (SAND—76-0729) **Optical properties of chemically sprayed CdS/Cu/sub x/S photovoltaic cells.** Berg, R.S.; Myers, T.M. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1977. Contract EY-76-C-04-0789. 39p. P 03/MF A01.

Cadmium sulfide/copper sulfide photovoltaic devices have shown a great deal of promise for inexpensive power generation. One of the most interesting fabrication techniques proposed for these devices is a chemical spray technique that can be integrated into a float glass substrate plant. The backwall cell being produced by this technique (under development by the D. H. Baldwin Company) requires the incident light to pass through the substrate, back contact, and CdS "window" before illuminating the junction. The cell properties are strongly affected by the optical properties of the constituent films and substrate. Absorption and reflection losses are up to 25% of the photons that can produce collectable electrical carriers. Reflection losses are an inherent property of the films, and are not recoverable. However, the absorption losses caused by impurities and structures are controllable. Additional photons are lost by transmission through the Cu/sub x/S due to its thinness. The limitations these properties impose on the device are discussed. Modifications and potential improvements are discussed. Limitations on the performance of the CdS/Cu/sub x/S cell do not appear to be caused by the chemical spray process used.

39406 **Silicon solar cell for use at high illumination intensities.** Lammert, M.D. Lafayette, IN; Purdue Univ. (1975). 193p. University Microfilms Order No. 76-20,467.

Thesis (Ph. D.).

A p^+-n^+ structure silicon solar cell, developed for use at high illumination intensities, is described. The various losses in solar cells are examined along with possible methods of reducing the losses. Results of a computer study of the p^+-n^+ solar cell are presented showing the effects of bulk lifetime, surface recombination velocity, device thickness, p to n finger width ratio, and illumination intensity. The development of a processing procedure for fabricating the p^+-n^+ solar cell is discussed along with the techniques of gettering and surface annealing to improve the device efficiency. Current-voltage characteristics were measured as a function of intensity for both a standard Eppley tungsten lamp and concentrated sunlight. The data resulting from these measurements is given in addition to a calculation of the device efficiency.

39407 **Silicon solar cells produced by corona discharge.** Wichner, R.; Charlson, E.J. (Lawrence Livermore Lab., CA). *J. Electron. Mater.;* **5**: No. 5, 513(1976).

A technique for producing p-n junction silicon solar cells was developed involving the use of a continuous gaseous discharge operating in the corona mode. The process is applicable to the production of p on n or n on p structures. Detailed results are presented for a BF_3 discharge, producing p on n cells, along with preliminary results using a PF_5 discharge, resulting in n on p cells. Efficiencies of over 8 percent were obtained on single crystal Si p on n cells, and of over 3 percent for a heavily-defected polycrystalline at AM1 without anti-reflective coatings. Fill factors as high as 0.76 were obtained. Analysis of these cells includes ion microprobe mass analysis and anodic stripping for concentration profiles, and capacitance-voltage and current-voltage measurements for electrical characterization.

39408 (N—76-27696) **The effect of particle photon radiation on solar cells. Final report.** Bielle-daspet, D.; Gasset, G.; Castanermunoz, L. (Toulouse-3 Univ., 31 (France). Centre d'Etude Spatiale des Rayonnements). Mar 1976. Contract ESTEC-1786/72. 133p. (ESA-CR—479). NTIS $6.00.

The degradation of n+/p solar cells manufactured from 10 ohm cm aluminum or boron doped silicon produced by the Czrochalski or floating zone process was studied. Results show that the influence of the dopant and silicon lingot fabrication process on the base region minority carrier lifetime increases in the case of electrons of rather low energy (1 MeV). It is also shown that prolonged photon irradiation, following exposure to particulate radiation, tends to affect the degradation of a solar cell. Photon irradiation acts simultaneously in two ways: it lowers the defect density by eliminating certain defects and it increases the density by creating new defects.

PHOTOSYNTHETIC CONVERSION

REFER ALSO TO CITATION(S) 40074

39409 (ERDA/USN/1027—76/4) **Ocean food and energy farm project. Subtasks No. 1 and 2: biological studies of M. pyrifera growth**

in upwelled oceanic water. North, W.J. (California Inst. of Tech., Pasadena (USA). W.M. Keck Lab. of Engineering Materials). Nov 1976. Contract E(49-26)-1027;DON-NOO123-76-C-0313. 267p. P 12/MF A01.

The primary objective of the research activities during 1975—1976 was to assess the capacity of artificially upwelled water to stimulate growth in Giant Kelp, Macrocystis. Although deep oceanic water is known to be rich in a number of plant nutrients, there was little assurance that all required elements would be present in the necessary amounts or as forms that could easily be assimilated. There was also a possibility that concentrations of the free forms of potentially harmful trace substances such as copper, might occur in deep water above the toxic thresholds. Original plans for 1975—1976 called for considerable experimentation with adult Macrocystis plants. Adults often attain lengths greater than 30 meters, may weigh hundreds of kilograms, and display massive foliage. Huge containments and large quantities of water and other materials are needed for performing nutritional studies on adult Macrocystis plants. One study was attempted involving maintenance of an adult plant in artificially upwelled water for eleven days. Although some useful results were obtained, the considerable outlay of effort and money did not appear to be justified. Much of the desired information could undoubtedly be gathered more efficiently by laboratory experimentation. Accordingly emphasis was switched from a few large-scale field studies to a variety of modest-sized activities under reasonably controlled conditions in our laboratory. The testing apparatus, experimental methodology, and results are presented and discussed in detail. (WHK)

39410 Ocean Food and Energy Farm Project. Wilcox, H.A. (Naval Undersea Center, San Diego, CA). pp 133-149 of In Ocean engineering mechanics. Monney, N.T. (ed.). New York; American Society of Mechanical Engineers (1975).

From Annual meeting of ASME; Houston, Texas, USA (30 Nov 1975).

See CONF-751106—P1.

The Ocean Food and Energy Farm Project is designed to explore and develop the ability to raise the giant California kelp (Macrocystis pyrifera) and/or other seaweeds, plants, and marine animals in the tropical and temperate oceans. Sponsored by agencies of the U.S. Government and private industry, the project is a three-phase, 11- to 15-year effort to result in a 100,000 acre (4×10^8 m^2) farm system in the Atlantic or Pacific by the 1985 to 1990 time period. This system is projected to produce foods, fuels, fertilizers, plastics, and other products for man's consumption at a rate sufficient to supply all the requirements for 2 to 5 persons per acre (2 to 5 persons per 4×10^3 m^2) of cultivated ocean. The productivity of the system is based on bringing the nutrients of the deep waters by means of wave-powered upwelling devices into contact with the solar energy of the surface waters. The Naval Undersea Center (NUC) in San Diego is managing this project and has emplaced a 7-acre (3×10^4 m^2) experimental farm system off the northern tip of San Clemente Island. This unit was recently destroyed by accident, but before that occurred a number of important scientific and engineering studies were accomplished by Professor Wheeler North of the California Institute of Technology and NUC personnel.

TOWER FOCUS POWER PLANTS

REFER ALSO TO CITATION(S) 39483

OCEAN THERMAL GRADIENT POWER PLANTS

REFER ALSO TO CITATION(S) 40074

39411 (COO/2895—1) **Design and modeling of solar sea power plants by geometric programming.** Wu, C.C. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)). Apr 1976. Contract EY-76-S-02-2895. 177p. P 09/MF A01.

Geometric programming, a nonlinear optimization technique, is used to design Solar Sea Power Plants (SSPP) which convert the thermal energy stored in the tropical water into electricity. First, the conversion process is described, and the hardware necessary to implement a binary-fluid, closed-Rankine cycle is identified. Next, steady-state analytical models for the major components are derived. These models are then used as the constraints of a geometric program whose objective function is the minimization of a particular function of the design variables of the SSPP. A variety of problems are solved. On one extreme, they include simply the design of a minimum surface heat exchanger for a SSPP, and on another extreme the selection of the various water pipes for a given ocean site, accounting for all the hydraulic losses. The geometric programming technique produces the optimum design and, more importantly, the sensitivity of the objective function at the optimum to variations in cost figures, constraint bounds, and arbitrary constants of the model. It is demonstrated in this dissertation that geometric programming is an economical and effective tool for the analysis and design of complex interacting engineering systems involving many variables and constraints. In particular, it is concluded that geometric programming is effective in a variety of situations encountered in the design of Solar Sea Power Plants.

39412 (COO/2895—2) **Analytical study of the irreversible losses associated with vapor flow in the evaporator of a Solar Sea Power Plant: the manifold problem.** Farthing, G.A. Jr. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)). Apr 1976. Contract EY-76-S-02-2895. 146p. P 07/MF A01.

The irreversible losses associated with the flow of vapor in the evaporator of a Solar Sea Power Plant are investigated analytically. These losses are important in such a plant because of the very small pressure difference (approximately 39 psia) available across the turbo-generator. The investigation is carried out via the solution of a fluid flow problem that has been traditionally referred to as the manifold problem. Fundamentally, a two-dimensional analysis using both the momentum equation and the Bernoulli equation is shown to be the most realistic approach to the solution of the outlet manifold problem. A new solution technique, based on the method of weighted residuals, is shown to be a good procedure for approximating the solutions of the Navier—Stokes equations for ideal flow in an outlet manifold. Using these ideal fluid solutions as a basis, two outlet manifold models are developed which are directly applicable to the flow of vapor in the evaporator of a Solar Sea Power Plant. One of these models, called a main, is developed in sufficient detail to predict the velocity profile in the manifold, as well as the overall pressure drop. The profiles predicted by the model are in good agreement with the published experimental results of other workers. A large number of charts, contained in the appendices, are generated using the two models. These charts are supplied for use as a design tool by future workers. Being directly applicable to the Solar Sea Power Plant, they should significantly reduce the time involved in the analysis of a conceptual evaporator design. Through the use of the models, it is shown that, while the flow losses in the evaporator are not negligible, they are not seen as a serious threat to the feasibility of a Solar Sea Power Plant, either.

39413 (COO/2895—3) **Effects of oceanic flow patterns on the thermal efficiency of Ocean Thermal Energy Conversion (OTEC).** Fry, D.J. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA). Dept. of Civil Engineering). Apr 1976. Contract EY-76-S-02-2895. 187p. P 09/MF A01.

This analysis examines the flow patterns produced by the intake of both warm and cold water into a OTEC power plant. It also examines the mixing and possible recirculation of waters discharged from the OTEC plant back to the ocean. Since no OTEC power plant now exists in large or small size, it is important to forecast and identify possible problem areas for future work. A specific case study is made of a plant nominally designed to produce 200 MW of power. A parameterized description is developed to aid in the mathematical analysis of the principal features of the oceanic flow patterns for the OTEC power plant. From this analysis, it is shown, for the 200 MW plant, that recirculation of ocean water, as large as 40 percent of the evaporator discharge flow reduces power output by less than 10 percent. Some pattern of evaporator recirculation is likely to occur. It is an important result of this study to show that such recirculation is neither critical to plant operation nor an expected cause of instability, that is, the plant does not shut itself off by evaporator recirculation. Condenser (cold) water recirculation into the evaporator (warm) water intake is much more critical than a recirculation between evaporator discharge and intake. Fortunately, discharge flow patterns appear to provide a simple basis to assure that this kind of recirculation can be wholly avoided. A simple, but useful, analysis of the heat budget for the Caribbean Sea is examined in order to address some questions on the impact of large numbers of OTEC facilities in the tropical ocean. The analysis presents a relationship between net power withdrawal and reduction in ocean mixed layer (surface) temperature for several possible ocean flow conditions.

39414 Hydrodynamics of Gulf Stream Ocean Thermal Power Plants. Kirchhoff, R.H.; Mangarella, P.A.; McGowan, J.G. (Univ. of Massachusetts, Amherst). pp 1-27 of In Ocean engineering mechanics. Monney, N.T. (ed.). New York; American Society of Mechanical Engineers (1975).

From Annual meeting of ASME; Houston, Texas, USA (30 Nov 1975).

See CONF-751106—P1.

This paper considers the external hydrodynamic aspects of Gulf Stream sited Ocean Thermal Power Plants. Specific details of the ocean resource including flow, temperature, and density profiles are examined for suitability at selected sites. In the light of the most current system design, a semi-submersible 400-MWe net power plant, the fluid mechanical details of the interaction of the hot and cold ocean water systems with the total system are studied. The hydrodynamic studies include determination of the characteristics of the inlet and exit of the hot water system for both natural pumped

evaporators (using kinetic energy of the Gulf Stream) and forced pumping systems. The hydraulic investigation of the cold water flow includes a determination of the withdrawal layer and effect on the site water stratification. Also, the characteristics of the condenser exhaust plume are examined to determine salinity concentration and flow pattern in the wake of the plant.

39415 Hydrothermal electric power plants and their characteristics. Astaf'ev, A.N.; Marochek, V.I. (Far East Polytech Inst im. V.V. Kuibyshev, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 9, 129-132(Sep 1976). (In Russian).

Data are presented on the characteristics of the equipment and of the entire complex of hydrothermal power plants that could be built on shore or on floating platforms and could use freon-11, freon-21, ammonia or steam as their working medium. It is concluded that a thermal gradient of the order of 23-25°C is required for setting up adequately efficient hydrothermal power plants. Metal consumption would be fairly high but it can be reduced by using polyethylene. Other conditions being equal, power plants using ammonia as their working medium appear to be the most efficient.

SOLAR RADIATION UTILIZATION

SPACE HEATING AND AIR CONDITIONING

39416 (COO/2688—76-10) **InterTechnology Corporation technology summary, solar heating and cooling. National Solar Demonstration Program.** (InterTechnology Corp., Warrenton, Va. (USA)). Dec 1976. Contract EY-76-C-02-2688. 242p. Dep. NTIS $8.00.

A summary of systems technology for solar-thermal heating and cooling of buildings is given. Solar collectors, control systems for solar heating and cooling, selective surfaces, thermal energy storage, solar-assisted heat pumps, and solar-powered cooling systems are discussed in detail. Also, an ITC specification for a solar control system is included. (WHK)

39417 (LA—6242-MS) **Pacific Regional Solar Heating Handbook.** Balcomb, J.D.; Grimmer, D.P.; Hedstrom, J.C.; Kerr, K.C. (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1976. Contract W-7405-ENG-36. 191p. Dep. NTIS $7.50.

A guide is given for engineers, architects, and individuals familiar with heating and ventilating applications, who wish to design a solar heating system for a residential or small commercial building in the Pacific Coast Region. Both air and liquid space heating systems and domestic hot water heating applications are presented in detail. Passive space heating and swimming pool heating systems are discussed qualitatively; a quantitative analysis is not available at this time. Sources of information are listed, and design considerations, collector types, and collector coolants are discussed. The active systems described and studied are as follows: (1) domestic hot water heating using liquid heating collectors; (2) space heating using liquid heating collectors, water heat storage, and forced air distribution; and (3) space heating using air heating collectors, rock-bed heat storage, and forced air distribution. Performance charts are presented for the three types of active solar heating systems. The analyses are based on hour-by-hour computer simulations using actual weather data from seven Pacific Regional cities. The required collector area has been determined for these cities in the four-state region, Arizona, California, Oregon, and Washington. A simplified approach to collector sizing is presented based on monthly solar radiation and temperature data. The effects of variations in importantdesign parameters have been studied extensively for Fresno, California, and are presented in graphical form. However, much of the information in the Handbook is generally applicable.

FURNACES

REFER ALSO TO CITATION(S) 39373

GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 39663

RESOURCE STATUS AND ASSESSMENT

39418 (AD-B—006304) **Geothermal energy in the Pacific region.** Grose, L.T.; Keller, G.V. (Colorado School of Mines, Golden (USA)). May 1975. Contract N00014-71-A-0430-0004. 180p. NTIS $7.50.

See also Appendices A and B, AD-B—006305L. Original contains color plates: All DDC reproductions will be in black and white.

If geothermal energy at remote naval bases is available for space heating, electricity generation, and in the future for synthesis of high-energy fuel (hydrogen), the bases would be largely energy independent and would be alleviated of costly dependence on supply ships especially critical in times of international crises. This report is a first phase study of the Intra- and Circum-Pacific region for delineation of areas that appear to warrant exploration for geothermal energy sources which may be utilized by the United States Navy. Basic tectonic, volcanic, heat flow, and thermal spring data are plotted on regional Pacific guadrant maps at scale of 1:20,000,000. Areas most attractive for further geothermal investigations are manifest by tensional neotectonism, Pliocene-Quaternary volcanism, supernormal heat flow, and occurrence of high-temperature springs. The thermogeologic regime of basically similar simatic Pacific areas is reviewed for the Galapagos Islands, Hawaiian Islands, and Samoan Islands, and numerous small volcanic islands are selectively pointed out to have possibilities for geothermal development. In the island-arc environment Adak, Fiji Plateau, Guam, and the Philippines are briefly described. A note on possible occurrence of geo-pressured sections in the Circum-Pacific is included. (GRA)

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

REFER ALSO TO CITATION(S) 39418, 40494

GEOTHERMAL POWER PLANTS

POWER PLANT SYSTEMS AND COMPONENTS

39419 (UTEC-ME—76-211) **Computer program for determining the thermodynamic properties of light hydrocarbons.** Riemer, D.H.; Jacobs, H.R.; Boehm, R.F.; Cook, D.S. (Utah Univ., Salt Lake City (USA). Dept. of Mechanical Engineering). 1976. Contract EY-76-S-07-1523. 88p. Dep. NTIS $5.00.

This program was written to be used as a subroutine. The program determines the thermodynamics of light hydrocarbons. The following light hydrocarbons can be analyzed: butane, ethane, ethylene, heptane, hexane, isobutane, isopentane, methane, octane, pentane, propane and propylene. The subroutine can evaluate a thermodynamic state for the light hydrocarbons given any of the following pairs of state quantities: pressure and quality, pressure and enthalpy, pressure and entropy, temperature and pressure, temperature and quality and temperature and specific volume. These six pairs of knowns allow the user to analyze any thermodynamic cycle utilizing a light hydrocarbon as the working fluid. The Starling—Benedict—Webb—Rubin equation of state was used. A brief description, flowchart, listing and required equations for each subroutine are included.

GEOTHERMAL ENGINEERING

39420 (SAN/1140—1/2) **Planning and design of additional East Mesa Geothermal Test Facilities. Phase 1B. Volume II. Procurement package.** Pearson, R.O. (TRW Defense and Space Systems Group, Redondo Beach, Calif. (USA)). 15 Oct 1976. Contract EY-76-C-03-1140. 375p. Dep. NTIS $10.50.

Procurement packages of technical specifications and construction drawings for eleven test facility additions to the ERDA East Mesa Geothermal Component Test Facility are presented. Each of the specifications includes all of the technical requirements needed for procurement and construction starting with Division 2. The information is presented under the following subject headings: injection pump system: 52-2 injection pipeline; control and instrumentation spools; calibration test bench; test pad modifications; test pad piping headers; production and injection wells; well 5-2 modifications; well 8-1 down-hole pump; well 6-1 down-hole pump; and well 8-1 booster pump. (JGB)

GEOTHERMAL DATA AND THEORY

PROPERTIES OF MINERALS AND ROCKS

39421 (LA—6695-MS) **Electron microprobe analyses of minerals in Precambrian rocks at the Los Alamos Scientific Laboratory Geothermal Test Site, Jemez Mountains, New Mexico.** Ehrenberg, S.N.; Perkins, P.C. (Los Alamos Scientific Lab., N.Mex. (USA)). Feb 1977. Contract W-7405-ENG-36. 15p. Dep. NTIS $3.50.

Electron microprobe analyses are presented for plagioclase, biotite, hornblende, magnetite, microcline, and chlorite in core samples from Granite Test Hole One at the Los Alamos Geothermal Test Site. The analyses and accompanying petrographic descriptions

characterize material that is being exposed to artificial hydrothermal systems in laboratory experiments. Plagioclase in granitoid rocks exhibits significant compositional variation (albite rims on calcic oligoclase) and alteration to sericite and epidote.

ROCK-WATER-GAS INTERACTIONS

39422 (LA—6696-MS) **Preliminary studies of the alteration of a granite by an artificial hydrothermal system.** Ehrenberg, S.N.; Perkins, P.C.; Balagna, J. (Los Alamos Scientific Lab., N.Mex. (USA)). Feb 1977. Contract W-7405-ENG-36. 18p. Dep. NTIS $3.50.

Solution channels in quartz, microcline, and plagioclase of a granite were produced by exposure of the rock to an artificial hydrothermal system. Electron microprobe analyses, beam-scanning photographs, and element profiles show that the mineral grains are homogeneous and unaltered within a few micrometers of the channels. The channels, which are 3 to 7 μ in diameter, appear to have formed by removal of material in solution. In the sample material, no new minerals produced by alteration or deposition were detected by microprobe analysis. The apparent absence of such alteration products (e.g., clays) may be due to (1) sample preparation which removed fine-grained alteration products during polishing; or (2) concentrations of such minerals in such small amounts that they are below the limits of detectability with the microprobe. The granite is seen to be preferentially attacked by the hydrothermal solution along grain boundaries and cracks. Similar solution effects are observed in amphibolites exposed to the artificial hydrothermal system. Plagioclase crystals in the amphibolite are partially dissolved so that delicate porous boxwork structures remain.

TIDAL POWER

REFER ALSO TO CITATION(S) 39714

WAVE ENERGY CONVERTERS

39423 **Mechanism for tapping the surf energy.** Tah-sun, L. US Patent 3,994,629. 30 Nov 1976. Filed date 18 Nov 1974. 4p.

A mechanism utilizing the energy of the surf including a gravitational bucket with a rack on the outside thereof is described. The rack engages a gear which drives a reciprocating water pump. The pump transports water to a tank for use later as a source of steady controllable energy. 4 claims, 3 figures.

39424 **Wave and tide actuated hydraulic electrical generating apparatus.** Long, C.S.; Long, J. US Patent 4,009,395. 22 Feb 1977. Filed date 4 Nov 1974. 8p.

A wave and tide actuated hydraulic electrical generating apparatus is described which includes a flotation chamber floatingly supported in a water containing basin area connected to a fluctuating water source, such as the tide and wave level of an ocean, the flotation chamber rising and falling with the changes in elevation of the water in the basin, such as caused by the movement of waves, with the chamber being linked by lever arms through suitable gear mechanisms to a multitude of piston rods associated with a like number of hydraulic cylinders which are connected in hydraulic parallel relationship, the movement of the flotation chamber in an upward direction effecting movement of the piston rods in a first direction relative to the cylinders, the movement of the flotation chamber in a downward direction effecting movement of the piston rods in the opposite direction in their associated cylinders, this movement of the piston rods in their associated cylinders effecting a pumping of hydraulic fluid to a hydraulic turbine to power the same, the turbine in turn being drivingly connected to an electric generator such that movement of the water in the basin effecting movement of the flotation chamber effects the generation of electrical energy by means of the hydraulic turbine powered by the hydraulic fluid from the hydraulic cylinders which are, in turn, operated by the lever arms connected to the flotation chamber. 1 claim, 4 figures.

39425 **Wave operated power plant.** Mattera, H.A.; Pitts, P.F.; Pitts, M.M. US Patent 4,009,396. 22 Feb 1977. Filed date 19 Nov 1975. 4p.

A wave operated power plant is provided wherein a buoyant vessel is anchored on the ocean surface with the wave motion causing displacement of water carried in a chamber in the hull such that upon rocking motion the water is forced upwardly through pipes on one side of the vessel. The water contacts turbine blades which through shafts rotate electrical generators and generate electricity. The water is returned to the chamber when the vessel moves in the opposite direction and the cycle is repeated with water forced up through pipes in the other side of the vessel, used for electrical generation and then returned to the chamber. The water being forced up from the chamber can contact the blades directly or be stored in a tank on top of the vessel and released at a predetermined rate. 4 claims, 4 figures.

WIND ENERGY

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 39400

WIND ENERGY ENGINEERING

TURBINE DESIGN AND OPERATION

39426 (NSF/RANN/GI—41891/FR/75/4) **Optimization and characteristics of a Sailwing windmill rotor. Final report, February 1, 1975—January 31, 1976.** Maughmer, M.D. (Princeton Univ., N.J. (USA). Dept. of Aerospace and Mechanical Sciences). Mar 1976. Contract NSF-G-GI-41891. 86p. Dep. NTIS $5.00.

A detailed accounting of the development and operational techniques of the Princeton moving-vehicle windmill testing facility is presented. Also presented is a complete documentation of the performance build-up (Cp/sub max/ = .06 to Cp/sub max/ = .40) of a 12 ft. diameter, two-bladed Sailwing rotor. An examination of an exploratory research effort directed toward using a small, first-stage, co-axial rotor to augment windmill performance is included. Finally considered are the results and conclusions of an extensive wind-tunnel test program aimed at a quantitative determination of the aerodynamic penalties associated with numerous simplifications of the basic double-membraned Sailwing cross-section.

ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 39581, 39666, 39701, 39702, 39704

39427 (EPRI-EM—285) **Synthetic electric utility systems for evaluating advanced technologies. Final report.** Zaininger, H.W.; Wood, A.J.; Clark, H.K.; Laskowski, T.F.; Burns, J.D. (Power Technologies, Inc., Schenectady, N.Y. (USA)). Feb 1977. 208p. P 10/MF A01.

It is important to have a systematic method of assessing alternative new technologies or new developments on utility systems throughout the country. One approach to making systematic, generic assessments is to utilize the methodology of utility system planning engineers such as load flow and stability calculations for transmission facilities and power production and reliability analysis for generation facilities. However, it is neither feasible nor necessary to make such generic assessments on large, detailed models of the U.S. power system. Instead, a practical solution is to use smaller, synthetic utility systems with characteristics representative of various portions of the U.S. utility system. Results are presented of this first step in the development of a systematic method of evaluating alternative new technologies on the U.S. power system: the development of representative scenario systems and data. Six generation and transmission scenarios, a "plug-in" distribution system, and typical data for utility system components have been developed. These systems and data are broadly representative of utility system characteristics as they are projected for the mid-1980s.

39428 (ERDA—77-37) **Systems engineering for power.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Electric Energy Systems). Mar 1977. 110p. P 06/MF A01.

The central objective of Systems Management and Structuring is to develop and make available to the electric utility industry the conceptual tools needed for planning, engineering, and Operating of electric energy systems of the future. This document is the second program report. The initial chapter includes an extensive discussion of the motivation for the program, its objectives, and the approach used for its development. The titles of the eight other chapters are: Status Report on the Emergency Operating State Control Contracts; Status Report on the Organizational Forms for Large Scale Systems Contracts; Status Report on Factors Influencing Utility Expansion Contracts; Status Report on Test Facilities; Project Summaries of New Projects in Automatic Generation Control--A Systems Approach; Project Summaries of New Projects in Energy Storage Evaluation Methods; Project Summaries of New Projects in Network Analysis and Synthesis; and finally, Newly Issued Request for Proposals--System Effectiveness. References and papers issued in relation to the contractual work are included at the end of each chapter. (MCW)

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 39606, 39707

39429 New requirements for the development and design of thermal energy systems. Stepanchuk, V.F.; Minkov, V.A. (B SSR Polytech Inst). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 9, 47-52(Sep 1976). (In Russian).

New requirements which should be met by steam power plants at the present stage of scientific and technical development are formulated and analyzed. In particular, the requirements to cut energy consumption per unit of output, to reduce air pollution, to adapt power plants to multiple fuel firing, and to adapt them to variable load graphs, are discussed.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

REFER ALSO TO CITATION(S) 40244

39430 (PB—257746) Hydrothermal modeling for optimum temperature control: an estimation-theoretic approach. Final report, 31 Dec 1974—31 Oct 1975. Schrader, B.P.; Moore, S.F. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.; New England Power Co., Westborough, Mass. (USA)). Jul 1976. 112p. (MIT-EL—76-007). NTIS $5.50.

Prepared in cooperation with New England Power Co., Westborough, Mass.

A short-term temperature forecasting (STF) system is proposed to predict and control plant intake and discharge temperatures at Salem Harbor Electric Generating Station. An STF system requires a simple hydrothermal model to predict hourly plant intake temperatures 24 hours ahead, with a pre-specified, minimum accuracy. An estimation-theoretic approach to model development is used, employing optimal filtering and full-information maximum-likelihood (FIML) estimation to obtain optimum parameter estimates. A two-basin, two-layer hydrothermal model of Salem Harbor is developed. (GRA)

39431 (ANL-Trans—1083) Temperature oscillations at critical temperature in two-phase flow. Brevi, R.; Cumo, M.; Palmieri, A.; Pitimada, D. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Feb 1977. Translation of Italian report. 40p. P 03/MF A01.

Some experiments on the temperature oscillations, or thermal cycling, which occur with steam-water flow in once-through cooling systems at the critical temperature zone, i.e., when dryout occurs, are described. A theoretical analysis is done on the characteristic frequency of the oscillations, and the parameters upon which the operating characteristics and the physical properties of the fluid depend. Finally, the temperature distribution in the critical zone is analyzed, examining the thermal transitions that occur due to the rapid variations in the coefficient of heat transfer.

POWER CYCLES

REFER ALSO TO CITATION(S) 39170, 39172

39432 Use of the 'exergy' function in an analysis of thermodynamic processes--2. Vivarelli, R.; Sciubba, E.; Guizzi, G.L. (Univ di Roma, Italy). *Termotecnica (Milan);* **30**: No. 10, 506-513(Oct 1976). (In Italian).

Practical examples are given of some applications of the questions examined in the first part of this paper (mainly the exergetical efficiency) to the analysis of thermodynamical cycles to define the real sources of energy losses in thermodynamical plants.

COMPONENTS

REFER ALSO TO CITATION(S) 39170, 39172, 39548, 39805, 39806, 39807

39433 (BNWL—2168) K-Area Boiler-Turbine-Alternator. Validation tests and validation project. Final report. McSpadden, W.R.; Greenbourg, J.; Mahan, R.E.; Nemec, J.F. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); United Nuclear Industries, Inc., Richland, Wash. (USA)). Jan 1977. Contract EY-76-C-06-1830. 111p. P A06/MF A01.

A project to develop and test mathematical models of the dynamic response of an electric power plant boiler-turbine-alternator (BTA) system to changes in control variables and load variations is described. Ultimately the mathematical models would be used to minimize the consumption of fuel by the power plant during transient conditions. The power plant to be instrumented and used for model validation was one of six 5-MVA units in the K-Areas of the Hanford Project near Richland, WA. The research required not only model development but also operation of the BTA system under instrumented, controlled conditions. Under these conditions, the response of the model could be compared with the response of the actual system and corrected or refined, if necessary to validate the model. The project was plagued with several major problems, such as the lead time required to complete all of the contracting and procurement activities, a three-fold expansion of the instrumentation system which caused cost increases and time delays, and a strike of operating and maintenance personnel. Because of these problems ERDA decided to cancel the project. Consequently the tests were never run to their completion, although considerable model development and instrumentation work was completed. The physical plant was operated to full speed and full pressure and its safety devices checked. Following the decision to terminate the project, the system was deactivated and moth-balled. At the present time there are no plans or funds to reactivate the project.

39434 Calculation of heat exchange during mixed convection. Alferov, N.S.; Balunov, B.F.; Rybin, R.A. *Teploenergetika (Moscow);* No. 6, 71-75(Jun 1975). (In Russian).

Based on an analysis of a large volume of data, practical recommendations are given with respect to the calculation of heat exchange for vertical heat exchangers in conditions of interaction between forced turbulent flow of the heat carrier and natural convection.

39435 Coal-fired BP-1150 Rafako-Sulzer monotube boiler for 350 MW power units. Mazurkiewicz, A. *Energetyka;* **30**: No. 7/8, 241-247(1976). (In Polish).

Design assumptions for a 360 MW power unit boiler are discussed. Economic results of the construction and introduction of this type of boilers into Polish power plants are presented.

39436 Unbalanced loading capabilities of large turbine generators. Takahashi, N. (Hitachi Research Lab., Japan); Kawamura, T. *Hitachi Hyoron;* **25**: No. 2, 65-70(Feb 1976).

The unit capacity of turbine generators has increased remarkably in recent years. Along with this tendency, heating of the rotor surface due to negative-sequence currents at line faults or unbalanced loading is increasingly becoming a factor in limiting the generator dimensions and inducing electric corrosion, local heating and vibrations. In order to increase unit capacity while securing reliability comparable to or better than that of existing generators, therefore, careful study must be made and the greater capability to endure the negative-sequence current must be achieved. An approach to solving this problem is proposed, viz., through analysis of rotor eddy currents, losses, and temperature rises as encountered in actual machines. The results of analyses were obtained for different types of damper windings used as a means of enhancing unbalanced loading capabilities. It was found that a full-length damper winding is effective for large capacity machines. Such a winding, therefore, can be used as a means of coping with future capacity boosts.

39437 Hitachi turbine fully automatic start-up system. Hanaoka, H.; Kawai, T. *Hitachi Hyoron;* **25**: No. 2, 71-76(Feb 1976).

The functions of the newly developed fully automatic start-up system for turbine generator plants are described. In addition to the functions of the previous system, viz., turbine speed control, synchronization, and load control, the new system is provided with the new functions of automatic start-up and shutdown of turbine plant auxiliaries and plant automatic runback in times of emergency. Every possible measure has been taken for enhancing hardware reliability. An IC plug-in system has been used, the equipment has been made compact, and noise-abatement devices have been introduced.

39438 Use of unconventional fluids for single stage supersonic turbines of low power output. Maizza, V. (Univ di Bari, Italy). *Termotecnica (Milan);* **30**: No. 8, 395-410(Aug 1976).

High molecular weight working fluids used in small turbines create a variety of problems since the flows are supersonic and consequently special attention is necessary in this respect in blading design. The factors influencing the blade profile performances are described and the phenomena involved in simple theoretical models are examined with particular attention to the effects of the thermal phenomena. The behavior of the trailing edge shock wave on blades discharging obliquely and their effect on performances are discussed in some detail. The turbine development problems posed by Mach number and other properties of unconventional fluids are illustrated and some such fluids were selected for analysis of their performance on the basis of some common parameters. Thiophene and Allied P-1D showed the best overall performance in a Rankine cycle power plant with a low power output turbine theoretically simulated by a digital computer. 33 refs.

39439 Gas turbine air intake systems in particular environments. Cossa, S. (AAF, Milano, Italy). *Termotecnica (Milan);* **30**: No. 10, 538-543(Oct 1976). (In Italian).

Atmospheric impurities in different environments are recalled and their effects on the erosion and corrosion of compressors are

considered. Gas turbine air intake systems in coastal and marine environments, in large cities, in industrial localities, in desert areas, in tropical and arctic regions are discussed.

39440 Technical features and test results of B.F. blower and thermal power plant for Sumitomo Metal Industries, Kokura Works. Sakagami, H.; Morita, S.; Okuyama, Y.; Higuchi, K.; Kitayama, Y.; Ikesawa, K.; Narita, S.; Akai, S. *Kawasaki Giho;* No. 62, 240-246(Dec 1976). (In Japanese).

A 35 MW power plant, consisting of a boiler and a single shaft set of a steam turbine, electric generator, and axial blower with clutch, was successfully installed in March 1976. Principal concerns in the planning of this plant were reduction of NO/sub x/ concentration in the boiler exhaust gas, automation of burner control and turbine start-and-stop operation, evaluation and reduction of vibration amplitude of the shaft of the turbine, generator, and blower, and expansion of the blower's operation range. Improvement has been confirmed in test running.

39441 Investigation of the TGM-94 steam generator in a 160 MW unit with operation in a controlling range of loads. Moseev, G.I.; Tugov, A.I.; Lazarenko, I.S. *Therm. Eng. (USSR) (Engl. Transl.);* **23**: No. 2, 6-10(Feb 1977).

Translated from Teploenergetika; 23: No. 2, 5-9(Feb 1976).

Experience has shown that TGM-94 steam generators can be operated at minimum loads of less than the attained levels of 40 to 45 percent of rated load. In order to substantiate the lower limit of continuous load allowable for reliable operation, 180 thermocouples were installed on the steam generator elements. The temperature conditions in all parts of the steam generator were monitored for operation modes from 100 to 20 percent rated load with oil or gas fueling and under varying combustion and furnace wall fouling conditions. The results showed that with respect to the thermal state of the heating surfaces, the TGM-94 steam generator can be unloaded from 20 to 25 percent of rated load and continuously operated at such loads at a drum pressure of at least 11 MPa; with the existing structural arrangement, in the case of operation of the generating unit at decreased pressure (below 10 MPa) considerable thermal and hydraulic stratifications occur in the economiser of the TGM-94 steam generator, substantially impairing the temperature conditions of the drum and of the outlet sections of the convective stage of the economiser; and, for full substantiation of the advisability of great and frequent control of load of the generating unit at variable pressure, it is necessary to take into account the factor of service life of the drum. (LCL)

39442 Transferring discharge of the medium from the integral separator into the deaerators in starting a 300 MW boiler/turbine unit. Golyshev, L.V.; Misyuk, A.V.; Prokopenko, A.G.; Lyashenko, L.I. *Therm. Eng. (USSR) (Engl. Transl.);* **23**: No. 2, 11-14(Feb 1977).

Translated from Teploenergetika; 23: No. 2, 9-12(Feb 1976).

In start-ups of 300 MW boiler/turbine units with once-through TGMP-314 steam generators, a technique was developed for changing the discharge of water from the starting flash tank into the deaerator, and the influence of this change on the quality of the feedwater was determined. It was found that complete transfer of discharge of the medium from the integral separator into the deaerator should be effected after the completion of hot washing of the circuit before the integral valve or after connecting the superheating circuit, and that, over the period of hot washing and before connecting the superheating circuit, a partial transfer of discharge of the medium from the integral separator into the deaerator should be affected with current monitoring of the quality of the feedwater.

39443 Experience with chemical treatment of high-sulfur oil by VNIINP-106 additive in PK-41 steam generators at Konakova Central Power Station. Pavlov, I.S.; Varfolomeev, Yu.I.; Garnyk, V.A.; Makarov, N.V. *Therm. Eng. (USSR) (Engl. Transl.);* **23**: No. 2, 15-18(Feb 1977).

Translated from Teploenergetika; 23: No. 2, 12-15(Feb 1976).

Fouling and corrosion of the high temperature and low temperature heating surfaces of steam generators caused by the use of high-sulfur fuel oils are discussed. Steps taken to prevent corrosion and fouling of the heating surfaces increase the reliability and service life, and in many instances, contribute to an increase in the efficiency of the steam generators. The most promising steps are those which make it possible to decrease the initial corrosivity of the oil combustion products. The use of organically based anticorrosive additives is assessed. It was found that chemical treatment of the fuel oil makes it possible to reduce fouling of the external heating surfaces and to decrease the intensity of corrosion of the high and low temperature heating surfaces. (RCK)

39444 Experimental study of radiant heat transfer at the exit surface of a furnace. Antonovskii, V.I.; Kiselev, O.V. *Therm. Eng. (USSR) (Engl. Transl.);* **23**: No. 2, 22-25(Feb 1977).

Translated from Teploenergetika; 23: No. 2, 25-28(Feb 1976).

A procedure for measuring radiant heat fluxes in the furnace space with the radiation probe is proposed which can be used in studying radiant heat transfer not only in the region of the furnace exit but also along the whole length of the flame in determination of re-radiation between individual zones of the furnace space. The method described for determination of spherical indications of intensity of radiation can be used in a study of the conditions of heat transfer in the wall-adjacent layers of furnace gas, in dividing the overall heat flux into radiant and convective heat fluxes, as well as in determination of the coefficient of thermal efficiency of the walls of the furnace chamber, i.e., in determination of radiant heat flux incident to the furnace wall and of inverse radiant heat flux (directly from the wall towards the flame) when with regard to formulation of the problem it is required to exclude the convective component of the heat flux of the sensor of the measuring instrument.

39445 Nature and features of the damage to waterwall tubes due to high-temperature corrosion in furnaces of supercritical steam generators with combustion of anthracite fines. Kaminskii, V.P. *Therm. Eng. (USSR) (Engl. Transl.);* **23**: No. 2, 26-29(Feb 1977).

Translated from Teploenergetika; 23: No. 2, 28-31(Feb 1976).

The high-temperature corrosion of waterwall tubes in steam generators with combustion of anthracite fines was studied. The main corrosive component of the furnace medium is hydrogen sulfide formed during combustion of the high-sulfur fuel. To increase the operational campaign of a studded waterwall and to reduce the corrosion of tubes, it is advisable to maintain a number of conditions; i.e., the length of the studs should be about 10 to 12 mm; the density of studding of the tubes in the corrosion zone should be not less than 0.2; the studs should be made of heat resistant and corrosion resistant steels (e.g., 00Cr8SiAl, Cr6SiAl, Cr12SiAl steels); tubes in the zone which is susceptible to corrosion should be covered by a protective layer; refractory gunite compositions having high heat resistance, slag resistance, and sufficient thermal conductivity should be used for the lining. In this respect, aluminium-chromium-phosphate underlayers and linings of waterwall tubes are of interest. To protect the waterwalls against corrosion their lining should be regularly inspected and restored when necessary. The necessary condition of decreasing corrosion is stable operation of bins, uniform supply of fuel to the burners, correct air conditions and correct aerodynamics of the operation of burners, prevention of contact of the flame with the waterwalls and decreasing the concentration of burning fuel at the waterwalls, e.g., by drawing the flame away from the waterwalls by means of rearrangement or by turning the end burners from the corrosion affected waterfall towards the center of the furnace.

39446 Tests of thermal power equipment and processing of results using the method of planning of an experiment. Girshfel'd, V.Ya.; Akimenkova, V.M.; Kulikov, V.E.; Borisov, G.M.; Udyma, S.P. (Moscow Power Inst.). *Therm. Eng. (USSR) (Engl. Transl.);* **23**: No. 2, 38-41(Feb 1977).

Translated from Teploenergetika; 23: No. 2, 38-41(Feb 1976).

The planning of parametric studies for determining the performance characteristics of thermal power plant components and methods for statistically evaluating the data from such performance testing are discussed. (LCL)

39447 Calculation on a digital computer of temperature fields of enclosures with heat conducting inclusions. Kozlov, Yu.V.; Konoplev, E.I.; Taran, L.I. *Therm. Eng. (USSR) (Engl. Transl.);* **23**: No. 2, 45-50(Feb 1977).

Translated from Teploenergetika; 23: No. 2, 43-48(Feb 1976).

The calculation of heat losses which occur in a thermal power plant due to thermal conduction through the housings and insulation on power plant components is discussed. (LCL)

39448 Turbine. Eskeli, M. US Patent 4,012,912. 22 Mar 1977. Filed date 22 Jan 1976. 4p.

A method and apparatus are described for the generation of power wherein a working fluid is compressed within outward extending rotor passages and then passed inward in other rotor passages with accompanying expansion and deceleration, with work being generated by the decelerating fluid. Heat may be added to the working fluid near the rotor periphery, and in closed rotors heat is removed from the working fluid after expansion. A regenerator also may be used mounted on the rotor exchanging heat between two streams of the working fluid. The working fluid passages during the deceleration are curved backward, while the working fluid passages for acceleration are usually radial. The working fluid may be either a liquid or gas, and the heating fluid and the cooling fluid may also be either a liquid or gas.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 39169

ECONOMICS

REFER ALSO TO CITATION(S) 39687, 39703

39449 Computer simulation for coal inventory optimization in the electric utility industry. Woods, P.B.; Bonser, J.S. (Pennsylvania Power and Light Co., Allentown). pp 611-617 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

A simulation tehnique for developing coal inventory policies in the electric utility industry is presented. The objective is to determine an optimum level of inventory for the company to maintain, in order to provide a cushion against both scheduled and random facility outages, at minimum total cost. The simulation and associated graphical output routines were written in PL/1 for an IBM System/370 computer at Pennsylvania Power and Light Company, Allentown, Pennsylvania. Although the study is based on operating data obtained from Company sources pertinent to the operation of their Brunner Island Steam Electric Station, the method is valid in its general form to other coal-fired stations on this and other electric utility systems. A model was developed which accurately simulates the system and operational functions at an electric utility generating station. Analysis of the results indicates that the technique is fairly insensitive to the frequency distributions employed in the various models, as well as the means and standard deviations of failure durations, and seems to suggest that substantial inventory savings are possible, assuming even adverse distribution functions. In particular, a 30 day inventory strategy appears to be near optimum, with resultant annual savings approximating $1,000,000. More conservative operating policies in the 35 to 40 day range would still yield annual savings in the order of $800,000, and represent virtually no risk of curtailed generation due to coal shortages. The technique developed provides management with a better, more quantified tool on which to base inventory policy decisions than had been available from other sources heretofore.

39450 Analysis of electrical power generation costs. Hardie, R.W.; Chamberlin, J.H. (Hanford Engineering Development Lab., Richland, WA). *Nucl. Technol.;* **33**: No. 2, 212-222(Apr 1977).

The relative competitiveness of nuclear and coal plants is assessed by dividing the U.S. into 21 regions and using a computer model to calculate costs for each plant in each region. Scenarios were considered in which resource depletion and environmental considerations affect coal generation costs. Analysis shows that if coal prices are constant in real terms and if SO_2 scrubbers are not required, nuclear plants produce electricity less expensively than coal plants in 45 percent of the country (adjusted for generation size). When either coal prices rise in real terms or when scrubbers are required, nuclear plants have the advantage in more than 90 percent of the market. In addition, sensitivity studies show that uncertainties in forecasting uranium and coal prices produce the largest difficulty in accurately comparing nuclear and coal electrical generation costs.

FUELS

39451 (PB—258523) **Fuel cycles for electrical power generation. Phase I. Towards comprehensive standards: the electric power case.** Pigford, T.H.; Keaton, M.J.; Mann, B.J. (Teknekron, Inc., Berkeley, Calif. (USA)). Jan 1973. Contract EPA-68-01-0561. 225p. (EEED—101). NTIS $7.75.

An illustrative data base for estimating environmental effluents from alternative technologies for thermally generated electrical power is presented. The data are to illustrate characteristics and possible magnitude of effluents to various environmental media and to illustrate the effect of choices of technology on the media effluents. The entire fuel cycle for each alternate technology is examined, representative sources of environmental effluents at each step in the fuel cycle are identified, and material and environmental quantities are indicated on a representative flow sheet for each means of generating electric power i.e., (1) light-water nuclear reactors, (2) low-sulfur bituminous coal, (3) residual fuel oil, (4) natural gas, (5) high-sulfur coal, with coal gassification and sulfur removal, (6) high-sulfur coal, with SO^2 recovery by wet-limestone scrubbing, (7) geothermal steam, (8) breeder fission reactor, (9) solar energy and, (10) thermonuclear fusion.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 39126, 39127, 39429, 39451, 40182, 40241, 40454

39452 (PB—257096) **Environmental impacts of the generation of electricity in the Pacific Northwest. Volume I.** (Equitable Environmental Health, Inc., Woodbury, N.Y. (USA)). Sep 1976. Contract DI-14-03-6103N. 269p. NTIS $9.00.

See also Volume 2, PB—257097.

The report describes and quantifies the environmental impacts of all existing plants and various scenarios for planned thermal electrical generating facilities through 1995 in the Pacific Northwest. The scope of the study includes the extraction, processing and transportation, as well as conversion of fuel for the generating facilities where these operations occur within the Pacific Northwest. Short-term and long-term, cumulative, synergistic, and regionwide impacts of a variety of types and configurations of power generation are assessed. (GRA)

39453 (PB—257097) **Environmental impacts of the generation of electricity in the Pacific Northwest. Volume II.** (Equitable Environmental Health, Inc., Woodbury, N.Y. (USA)). Sep 1976. Contract DI-14-03-6103N. 205p. NTIS $7.75.

See also PB—257096.

Short-term and long-term, cumulative, synergistic, and regionwide impacts of a variety of types and configurations of power generation are assessed. The approach of this study is to focus on the pathways and effects of residuals from power generation. These residuals are the releases to, or intrusions on, the environment and include air pollutants, water pollutants, solid waste, land disturbance, and noise. (GRA)

39454 Use of evaporators for water preparation: the basis of establishing effluent-free thermal power stations. Buskunov, R.Sh.; Kostrikin, Yu.M.; Shvetsova, V.P.; Shkol'nik, G.T.; Pozhitkova, E.V. *Therm. Eng. (USSR) (Engl. Transl.);* **23**: No. 2, 56-58(Feb 1977).

Translated from Teploenergetika; 23: No. 2, 60-62(Feb 1976).

At practically all thermal power plants the makeup (or feed) water is prepared by chemical demineralization. Liquid wastes from a demineralization plant contain salts which should not be discharged into surface waters. A cleaning system which uses evaporators working on flash distillation to recover dry salts from the demineralization effluents is described. (LCL)

THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 40249, 40449

39455 Prediction of fog over cooling ponds. Hicks, B.B. (Argonne National Lab., IL). *J. Air Pollut. Control Assoc.;* **27**: No. 2, 140-142(Feb 1977).

To predict the effects corresponding to various options available in early design stages of cooling ponds, it is necessary to develop simple rules which can be used to extrapolate from meteorological observations. The paper develops a revised and improved index from physical arguments. A "Fog Excess Water Index" (FEWI) can be derived from simplistic considerations of the humidity field in the vicinity of a cooling pond. This approach seems to be a better measure of cooling pond fog susceptibility than the "Fog Index Number" (FIN) of Currier et al.; it also has the benefit of being based on a simple physical model. (CAJ)

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 39116, 39124, 39166, 39440, 40138

39456 Maximum capacities of electric power plants taking account of air pollution with sulfur and nitrogen oxides. Popov, A.I.; Tyapchenko, V.K. (Saratov Polytech Inst, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 8, 57-62(Aug 1976). (In Russian).

Pollution of the atmosphere with sulfur and nitrogen oxides when burning sulfurous and high sulfur-content fuel oil at steam power plants (condensing and heat-and-power plants) is considered. Formulas for the determination of maximum capacity of thermal power plants burning fossil fuels are presented. They allow account to be taken of the overall effect of different components, qualitative fuel indices and concrete characteristics of the area in which the plant is situated. Calculations show that 250 and 350 m high smoke stacks at high-capacity power plants, in a majority of cases, do not meet the air pollution abatement requirements. In the long run, smoke stacks 500 m high and higher will be required.

39457 Simultaneous removal of nitrogen oxides and sulfur oxides from combustion gases. Clay, D.T.; Lynn, S. (to Energy Research and Development Administration). US Patent 3,987,146. 19 Oct 1976. Filed date 7 Aug 1975. 12p.

PAT-APPL-602,708.

A process is described for the simultaneous removal of sulfur oxides and nitrogen oxides fom power plant stack gases comprising contacting the stack gases with a supported iron oxide catalyst/ absorbent in the presence of sufficient reducing agent selected from the group consisting of carbon monoxide, hydrogen, and mixtures thereof, to provide a net reducing atmosphere in the SO/sub x// NO/sub x/ removal zone. The sulfur oxides are removed by absorption substantially as iron sulfide, and nitrogen oxides are removed by

catalytic reduction to nitrogen and ammonia. The spent iron oxide catalyst/absorbent is regenerated by oxidation and is recycled to the contacting zone. Sulfur dioxide is also produced during regeneration and can be utilized in the production of sulfuric acid and/or sulfur.

39458 Process for removing sulfur dioxide and nitrogen oxides from gases. Henis, J.M.; Tripodi, M.K. (to Monsanto Co.). US Patent 4,011,299. 8 Mar 1977. Filed date 1 Oct 1975. 12p.

Process is described for removing sulfur dioxide and nitrogen oxides from gaseous mixtures which comprises contacting such mixtures, in the presence of a reducing agent comprising carbon monoxide, hydrogen, or mixtures thereof, with a solid reagent comprising calcium oxide, magnesium oxide, or mixtures thereof at temperatures in excess of about 700°C.

39459 Method for simultaneous removal of SO/sub x/ and NO/sub x/. Fukui, S.; Nishino, H.; Kameoka, Y.; Miyazaki, J.; Kuroda, T.; Konishi, S. (to Chiyoda Chemical Engineering and Construction Co. Ltd.). US Patent 4,011,298. 8 Mar 1977. Priority date 18 Dec 1973, Japan. 16p.

Waste gas containing sulfur oxide (SO/sub x/) and nitrogen oxide (NO/sub x/) is mixed with an ozone-containing gas to have the value x of NO/sub x/ fall in the range of 1.2 to 2.5 and thereafter brought into contact with an aqueous solution containing sulfuric acid, nitric acid and an iron compound to be deprived of SO/sub x/ and NO/sub x/. To the solution with which the waste gas has been brought into contact, air or oxygen is added to effect oxidation of the part of said oxides still remaining therein in an unoxidized state and regenerate the activity of the iron compound functioning as a catalyst. Part of the solution to which the addition of air or oxygen has been made is recycled as the solution for the purpose of contact with waste gas.

39460 Process for regenerating absorbing solution used for exhaust gas purification. Adachi, K.; Gorai, T.; Ohami, K.; Takahashi, T.; Mizukami, T. (to Chisso Corp.). US Patent 4,013,430. 22 Mar 1977. Priority date 28 Dec 1974, Japan. 6p.

In the process wherein industrial exhaust gases containing nitrogen oxides and SO_2 are treated with an absorbing solution containing an iron chelate complex and a sulfite to remove nitrogen oxides and SO_2, the absorptivity of the solution is reduced sometimes because of dithionate formed during the treatment. The absorptivity-reduced absorbing solution is regenerated by heat-treating the solution at a pH of 3.0 or lower and a temperature of 80°C or higher whereby the dithionate is decomposed.

SITE SELECTION AND LAND USE

39461 (PB—260582) **Effectiveness of gas recirculation and staged combustion in reducing NO/sub x/ on a 560-MW coal-fired boiler. Final report.** Carr, R.C. (KVB Engineering, Inc., Tustin, Calif. (USA)). Sep 1976. 112p. Q 06/MF A01.

A field test program was conducted to determine the feasibility of using flue gas recirculation into the combustion air and two-stage combustion to reduce nitric oxide emissions on pulverized coal-fired utility boilers. Nitric oxide emissions were documented as a function of gas recirculation rate, excess oxygen level, unit load, and burner out-of-service pattern. Four basic boiler firing configurations were compared. Windbox gas recirculation is relatively ineffective in reducing NO emissions by comparison to two-stage combustion. No operational difficulties were encountered that would immediately preclude long term operation with flue gas recirculation or staged combustion although the program was not of sufficient duration to explore potential long term concerns with tube erosion or corrosion. The test program was conducted on a 560 MW unit at the Hatfield's Ferry Station of West Penn Power.

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 39656, 39708

39462 Calculation of energy losses and regimes in electric networks of up to 1000 v with incomplete initial data. Sych, N.M.; Fursanov, M.I.; Ulasevich, A.F. (B SSR Polytech Inst). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 8, 109-112(Aug 1976). (In Russian).

A method and program of calculation and analysis of energy losses and operating conditions in distribution networks of up to 1000 V are worked out and proposed. The effectiveness of an algorithm is demonstrated on an example of its realization in two electric power systems.

39463 Investigation of the stability of load nodes following disturbances in the supply network, taking account of automatic protection. Kalentionok, E.V.; Faibisovich, V.A. (Belenergoremnaladka, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 9, 109-112(Sep 1976). (In Russian).

Results of an analysis of transient processes of asynchronous loading following a change in the emf E or of reactive resistance in the supply network, taking account of the action of the automatic protection devices, are presented. An algorithm is proposed for an automatic protection device designed to prevent the development of breakdowns in the critical nodes of a power system. The effect of a number of factors on the value of the disconnectable load required to ensure stable operation for the remaining consumers is investigated.

AC SYSTEMS, EHV AND UHV

39464 (EPRI-EL—312) **Program to evaluate, develop, and test Poroplastic materials as improved electrical insulation for high power underground cables. Final report.** Nichols, L.D.; Gilson, L.; Obermayer, A.S. (Moleculon Research Corp., Cambridge, Mass. (USA)). Apr 1977. 66p. P 04/MF A01.

Results are presented of a project to develop Poroplastic Film, an ultramicroporous material used as a low loss substitute for the cellulose paper tapes presently used in the manufacture of high pressure oil-filled cable. Structurally, Poroplastic is a stable film consisting of a cellulose triacetate matrix which incorporated a large column of liquid. Pore diameters in the matrix measure several tens of Angstroms and the relative liquid volume can be controlled to range from as little as 50 percent to as much as 95 percent. The dimensional stability of the film is dependent on the presence of the liquid within the matrix; loss of liquid through evaporation or high pressure expulsion leads to irreversible collapse of the matrix. For use as a cable dielectric, the liquid incorporated in the Poroplastic was a dielectric oil. By virtue of the high oil loading, the material exhibited dielectric properties superior to those of cellulose paper; typically a power factor of 0.07 percent, a relative dielectric constant of 2.2 and a 60 Hz breakdown stress of 80 kV/mm (2 kV/mil). Mechanically, however, the basic material was inferior to cellulose paper in terms of its tensile, stiffness, frictional and fluid transport characteristics. The fluid transport properties of the material could be improved through embossing of its surface. This approach, however, is critically dependent on the long-term dimensional stability of the material. In terms of its mechanical properties, the greatest improvement was achieved through incorporation of woven glass cloth reinforcement. This approach, however, resulted in substantial increases in the power factor and cost of the material. The high cost of the material which was evolving, coupled with the difficult technical problems yet to be overcome, did not warrant further continuation of this work at this time.

39465 (EPRI-EL—362) **Investigation and status report on concentric neutral corrosion of URD extruded cable. Final report.** Husock, B.; Rizzo, F.E.; Kroon, D.H. (Harco Corp., Medina, Ohio (USA)). Jan 1977. 234p. P 11/MF A01.

The use of cables with extruded insulation and concentric neutral wires has been widely accepted for underground distribution in recent years and substantial continued use of this cable is anticipated. Recent reports of incidences of corrosion of the neutral strands have produced concern about problems which may result. The integrity of the neutral wires is important because it provides a low impedance both for load and short circuit currents and maintains acceptable voltage levels to equipment and personnel during short circuit conditions. A compilation of the information obtained from a literature search and a field investigation is presented. Results obtained in corrosion surveys of underground residential distribution (URD) cables are also included. The study concentrated on ascertaining present opinions about the cause or causes of concentric neutral corrosion and on determining present industry practice in corrosion mitigation. This investigation found no general agreement about the cause of concentric neutral corrosion and indeed there was even disagreement about the extent and seriousness of the problem. It is concluded that the neutral corrosion results from either stray dc currents or natural galvanic action and that ac is not an important factor. Present mitigation practice focuses mostly on jacketing and cathodic protection. There is a need for additional work in determining the effectiveness of these practices and in prescribing procedures for their use.

39466 (EPRI-EL—374) **Study of underground power cable installation methods. Final report.** Nicol, J. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Apr 1977. Contract EX-76-C-01-1824. 106p. P 06/MF A01.

It has been determined by the utility industry that the costs of installing underground high voltage transmission cable can be 50 percent of the total circuit in service cost. This study was directed towards underground cable systems in service and those types that can be commercially available in the near future. Detailed examination of the various installation steps was made and a range of costs were presented for each. After analyzing those higher cost steps for each cable type studied, various technologies were identified that could reduce these costs if utilities adopted these methods for use in other areas of construction. The result of these analyses was to recommend research and development in three general areas of

installation procedure, i.e., route planning and design, pavement and soil removal, and pipe installation methods. Recommendations in the route planning and design area were improved computer routing; subsurface preliminary surveying; thermal analysis of in-situ soils, backfill material, and how cable circuits are geometrically arranged in the trench. In pavement and soil removal, recommendations for improved methods yielded topics in the areas of microwave, plasma torch and water jet concrete cutting; improved guided boring systems; shoring techniques; and soil removal systems. The installation of pipes yielded R and D recommendations for automatic welding techniques, integrated transmission systems, and standardization of accessories and equipment among utilities.

39467 (EPRI-EL—393) **Development of a current limiter using vacuum arc current commutation. [Phase I: a feasibility study for using arc instability in vacuum for current limitation]. Final report.** Kimblin, C.W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Central Research Labs.). Mar 1977. 147p. P 07/MF A01.

There is a stated need by the Electric Utilities for fast acting current limiting devices which insert appreciable impedance into power circuits. Insertion of this impedance during the initial rise of fault current reduces the fault current peak, and simplifies the interruption requirements of conventional circuit breakers. Reduction of the fault current peak also reduces the electromagnetic forces which would otherwise damage circuit components such as power transformers, line traps, bus structures, disconnect switches, and breakers. A current limiter using vacuum arc current commutation is being developed. Progress in Phase 1 of this program is reported. The use of forced instability of vacuum arcs to insert an impedance into the line during the fault current rise was investigated. It was found that application of a transverse magnetic field is an effective and attractive method for causing current commutation into a current-limiting resistor. The interaction of vacuum arcs with applied transverse fields was analyzed theoretically and experimentally.

39468 Digital control of a large hybrid power simulator. Pomeroy, W.C. (Hewlett-Packard Co., Palo Alto, CA); Ott, G.E.; Walker, L.N.; Wong, D.; Leavene, R.W. pp 88-94 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

A faster than real-time hybrid simulator for the long term dynamics of large power systems has been developed. In this hybrid simulation a single-phase, integrated circuit ac analog model scaled 20 times faster than real-time has been developed. The model includes 16 power generation units with excitation and boiler dynamics, 61 transmission lines, 68 buses, 25 transformers, and 34 loads which are a function of voltage and frequency. These new large scale hybrid computers (4,000 amplifiers) impose new requirements on the digital system which were not present in previous, smaller scale, hybrid computer systems. The complete requirements for a high performance digital-analog data transfer system are specified, and the design of such a system is presented. Major emphasis is placed on the speed and expandability of this system as well as its adaptability to a wide variety of hybrid system requirements. This system operates on a 100 ms scan with 240 analog voltage measurement points, 220 16-bit word digital monitors, and 185 16-bit word digital controls. The system uses a TI 908A minicomputer with 24K word memory, moving head disc, and dual cartridge tape.

39469 Progress in hybrid simulation of power systems. Hedin, R.A.; Priest, K.W. (Allis-Chalmers Corp., Milwaukee). pp 95-101 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

Progress in hybrid simulation in three areas of power systems analysis is discussed. In transient analysis, the analog computer is used to simulate the major electrical apparatus and bus connections. The digital computer simulates the time delay associated with the transmission lines. In addition, the digital computer processes the input data, sets the appropriate analog pots and integrators, and plots various output data. In subsynchronous resonance analysis, the hybrid computer permits simulation of the simultaneous interaction of the electrical network, the generator, excitation system and the turbine-generator torsional systems. The application of the hybrid simulator to the investigation of surge arrester location analysis has made it possible to investigate complex substation layouts. The hybrid simulator has proved to be a valuable tool in the simulation of power systems.

39470 Some aspects of power system simulation, analysis, and optimum control. Sarma, M.S. (Northeastern Univ., Boston). pp 177-179 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

Modern power systems represent the largest man-made system in existence from the view point of invested capital. With the current rise in the demand of electrical energy, present-day power systems, which are large and complex, will continue to grow both in size and complexity. Also, our dependence on electrical energy is so great that it is essential to have uninterrupted supply of electrical power within set limits of frequency and voltage levels, and that it becomes a dire necessity to develop methods for effective control and operations of power systems. Continual modification and improvement of power-system simulation are required to offer the tools necessary to analyze tomorrow's systems. The problem of optimum control of a power system has been the object of constant attention of power-system engineers in modern times and its importance is understandably enhanced in these times of energy shortage. Some aspects of power-system simulation, analysis, and optimum control are presented.

39471 Real-time system identification using noisy measurements with application to computer controlled power system operation. Dwarakanath, M.H.; Dopazo, J.F.; Sasson, A.M. (American Electric Power Service Corp., New York). pp 223-228 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

A recursive algorithm for the identification of the parameters of linear, discrete-time, multi-input, multi-output, nondynamical and dynamical systems using noisy input and output measurements is presented in detail. Convergence characteristics of the algorithm for arbitrary choice of initial values of the matrices described in the sequel are considered in detail. An application of the recursive identification algorithm for the assessment of system security of a computer—controlled power system network is presented with the simulation results.

39472 FEP/C laminated paper of oil-filed cable for 1,000kV and above. Numajiri, F.; Oka, K.; Hanano, Y. *Hitachi Hyoron;* **25**: No. 2, 91-96(Feb 1976).

Fluorinated ethylene propylene copolymer (FEP) was selected as a substrate material of laminated composite for ultrahigh-voltage (UHV) oil-filled cable. The laminated composite developed consists of a FEP film laminated with cellulose paper on both sides (FEP/C laminated paper). It has a very low dissipation factor (below 0.07 percent at 80°C) and a high ac dielectric strength (above 45kV/mm). Also its mechanical properties are more excellent than those of low-loss cellulose paper. The manufacturing process for FEP/C laminated paper and its electrical and mechanical properties are described.

39473 Evaluation of economic and design parameters of phase conductors for a zone of equieconomic solutions. Aleksandrov, G.N.; Lisochkina, T.V. (Leningrad Polytech Inst im. M.I. Kalinin, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 8, 10-18(Aug 1976). (In Russian).

The vagueness of initial data and the flat character of the function of specific reduced costs in the vicinity of the mathematical optimum determine the presence of zones of equieconomic values of economic parameters (current density and the degree of limitation of the corona discharge) and design parameters (the number and radius of components) of an UHV electric power transmission line (1150 kV). The decision is arrived at by superimposing on a set of optimal designs, corresponding to the economic criterion of minimum reduced costs, a series of additional constraints depending on the character of the projected line.

39474 Gas-filled high-voltage cable built up of rigid segments. Van Deventer, G.C.; Visser, G.A. (to N.K.F. Kabel B.V.). US Patent 4,011,396. 8 Mar 1977. Filed date 6 Dec 1974. 4p.

A high voltage cable is described that is filled with an insulation gas under an operating pressure of more than 1 Bar, in which one or more conductors are supported by insulators, embedded in a tubular sheath of interconnected rigid elements and in which the gas-filled spaces of adjacent segments are connected together through a sealing element. This element is open under operating conditions and is closed when the pressures in the adjacent segments differ by more than a predetermined pressure difference.

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

39475 (BNL—22202) **Power transmission project: progress through fiscal year 1976.** (Brookhaven National Lab., Upton, N.Y. (USA)). 27 Dec 1976. Contract EY-76-C-02-0016;EPRI-RP-78-441;NSF-AG-381. 273p. P 02/MF A01.

One year's work on the development of helium-cooled niobium-tin superconducting cables for 550 kV or higher power transmission lines is summarized. Information is included on: conductor research involving the fabrication, materials testing, and perfor-

mance testing of Nb_3Sn tapes; design, materials testing and performance testing of cable insulation; mechanical and cryogenic engineering of transmission line components and of test facilities; and accumulated data on the design and testing of existing helium-cooled transmission lines in the Pennsylvania, study, Philadelphia Electric study, and LILCO (Long Island) study. (LCL)

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 39427, 39666

39476 (EPRI-NP—326-SR) **Modeling and estimating system availability.** Gaver, D.P.; Chu, B.B. (Electric Power Research Inst., Palo Alto, Calif. (USA)). Nov 1976. 63p. P 04/MF A01.

Mathematical models to infer the availability of various types of more or less complicated systems are described. The analyses presented are probabilistic in nature and consist of three parts: a presentation of various analytic models for availability; a means of deriving approximate probability limits on system availability; and a means of statistical inference of system availability from sparse data, using a jackknife procedure. Various low-order redundant systems are used as examples, but extension to more complex systems is not difficult.

39477 **Steam table routines for the simulation of nuclear power plants.** Hall, C.A. (Univ. of Pittsburgh); Mutafelija, B.A.; Rapp, J.P. pp 180-182 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976). See CONF-760703—.

The dynamic simulation of nuclear power generating stations requires evaluation of a large number of steam and water properties at every integration time step. Some of the interpolation/approximation methods presently used are described with particular emphasis on the use of the bilinear transfinite interpolation method. The fundamental requirements for the steam table routines are outlined and different approaches are compared. The superiority of the bilinear transfinite interpolation method is discussed. The use of the steam table functions in real-time simulation is of particular interest.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 39521, 39522, 39526, 39553, 39557, 39583, 39584, 39593, 39600, 39601, 39864, 39885

39478 (EPRI-NP—243) **Analysis of N-16 radiation measurements at the Cooper Nuclear Station. Final report.** Wells, M.B.; Swanson, R.L. (Radiation Research Associates, Inc., Fort Worth, Tex. (USA)). Apr 1977. 136p. P 07/MF A01.

A set of computer calculations are described that were run to predict N-16 gamma-ray dose rates at various locations on the surface of the components of the turbine equipment, on the roof of the turbine building, and at site locations in the vicinity of the Cooper Nuclear Station. The calculations of the N-16 source strengths in the turbine equipment were based on an assumed N-16 activity of 113 μCi/gm of steam at the reactor nozzle. Included in the report are descriptions of the QADMOD point kernel radiation transport code and the SKYSHINE procedure. These computer codes were used to compute the N-16 source strengths in the turbine equipment and to compute the N-16 dose rates at the various detector locations. Also described are the computer models used to represent the turbine equipment sources and the structure of the turbine building in the computer calculations.

39479 (EPRI-NP—369) **Light water reactor fuel rod modeling code evaluation. Final report.** Freeburn, H.R.; Pati, S.R.; Fiero, I.B. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Mar 1977. 267p. P 12/MF A01.

Six (6) fuel rod modeling codes have been evaluated for potential use by the electric utility industry. The evaluation consists of a summary and qualitative comparison of relative code attributes and weaknesses, and a ranking of the codes according to objective and subjective criteria. Accordingly, the codes have been ordered as follows: COMETHE-IIIJ, BEHAVE-4 and LIFE-THERMAL-1, GAPCON-THERMAL-2, and CYGRO-3 and FMODEL. COMETHE-IIIJ has been judged to be the most versatile code for applications to both thermal and structural analyses of Zircaloy-clad UO_2 fuel rods, and also can provide considerable savings in computer running times relative to the next two best codes. BEHAVE-4 has an excellent potential for structural analysis while LIFE-THERMAL-1 has an excellent potential for thermal analysis. Only CYGRO-3 and FMODEL are judged to be unsuitable in their present state for application by the utility industry, considering the alternatives available in the higher-ranked codes.

39480 (N—76-26975) **Estimation of the core-wide fuel rod damage during a LWR LOCA.** Mattila, L.; Sairanen, R.; Stengard, J.O. (Valtion Teknillinen Tutkimuskeskus, Helsinki (Finland)). 1975. 23p. (PUBL—12). NTIS $3.50.

The number of fuel rods puncturing during a light water reactor loss-of-coolant accident must be estimated as a part of the plant radioactivity release analysis. Due to the great number of fuel rods in the core and the great number of contributing parameters, many of them associated with wide uncertainty and/or truly random variability limits, probabilistic methods are well applicable. A succession of computer models developed for this purpose is described. Deterministic models are shown to be seriously inadequate and even misleading under certain circumstances. A simple analytical probabilistic model appears to be suitable for many applications. Monte Carlo techniques allow the development of such sophisticated models that errors in the input data presently available probably become dominant in the residual uncertainty of the corewide fuel rod puncture analysis.

39481 (PB—257054) **Occupational radiation exposure at light water cooled power reactors, 1969—1975.** Murphy, T.D.; Dayem, N.J.; Bland, J.S.; Pasciak, W.J. (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Nuclear Reactor Regulation). Jun 1976. 25p. (NUREG—0109). NTIS $3.50.

The report presents an updated compilation of occupational radiation exposures at commercial light water cooled power reactors for the years 1969 through 1975. The information is derived from reports submitted to the United States Nuclear Regulatory Commission in accordance with requirements of individual plant Technical Specifications and Part 20.407 of Title 10, Chapter 1, Code of Federal Regulations (10 CFR Part 20.407). The MAN-REM/UNIT for all LWR's in 1975 is greater than the 1974 value. The cumulative average since 1969 continues to increase. No significant trend was indicated over the period of 1969-1975 in the mean value of MAN-REM/MEGAWATT-YEAR. (GRA)

39482 **Bypass flow distribution in a boiling water reactor.** Carlson, R.W. (Georgia Inst. of Tech., Atlanta); Gott, D.R. *Nucl. Technol.;* **33**: No. 2, 161-173(Apr 1977).

The distribution of the bypass flow near the center of a boiling water reactor was calculated with the aid of the COBRA IIIC computer program to determine if boiling of the bypass coolant does occur. A consistent solution for the heat flux traversing the fuel assembly shroud and the bypass flow distribution was obtained for cases with the control rods fully withdrawn and also partially inserted. It was shown that the axial interval between calculated points must be approximately 1 cm to obtain a solution that is independent of the spacing between points. Boiling was found to occur in the flow channels that represent the intersection of the narrow gaps between fuel assemblies; however, the average exit enthalpy of the bypass flow was subcooled. Insertion of control rods had a small beneficial effect in reducing the boiling. A 40 percent increase in the bypass flow rate was found necessary to eliminate boiling completely.

39483 **Energy investment in nuclear and solar power plants.** Moraw, G.; Schneeberger, M.; Szeless, A. (Kernkraftwerk-Planungsgesellschaft m.b.H., Vienna). *Nucl. Technol.;* **33**: No. 2, 174-183(Apr 1977).

Energy analysis has been used to compare the energy investments for construction and operation of a nuclear and a solar power plant, both having the same electrical output. By means of dynamic energy analysis, construction programs for nuclear and solar power were investigated with respect to the necessary energy investment. It turns out that, considering only the energy investment aspect, present-day light water reactors use considerably less energy for their construction and operation than do solar thermal conversion plants.

39484 **Plutonium assemblies in reload 1 of the Dodewaard Reactor.** Bairiot, H. (Belgonucleaire, Brussels); Deramaix, P.; Vandenberg, C.; Leenders, L.; Mostert, P. *Nucl. Technol.;* **33**: No. 2, 184-202(Apr 1977).

Since 1963, Belgonucleaire has been developing the design of plutonium assemblies of the island type (i.e., plutonium rods inserted in the control zone of the assembly and enriched uranium rods at the periphery) for light water reactors. The application to boiling water reactors (BWRs) led to the introduction, in April 1971, of two prototype plutonium island assemblies in the Dodewaard BWR (The Netherlands): Those assemblies incorporating plutonium in 42 percent of the rods are interchangeable with standard uranium assemblies of the same reload. Their design, which had to meet these criteria, was performed using the routine order in use at Belgonu-

cleaire; experimental checks included a mock-up configuration simulated in the VENUS critical facility at Mol and open-vessel cold critical experiments performed in the Dodewaard core. The pelleted plutonium rods were fabricated and controlled by Belgonucleaire following the manufacturing procedures developed at the production plant. In one of the assemblies, three vibrated plutonium fuel rods with a lower fuel density were introduced in the three most highly rated positions to reduce the power rating. Those plutonium assemblies experienced peak pellet ratings up to 535 W/cm and were discharged in April 1974 after having reached a mean burnup of approximately 21,000 MWd/MT. In-core instrumentation during operation, visual examinations, and reactivity substitution experiments during reactor shutdown did not indicate any special feature for those assemblies compared to the standard uranium assemblies, thereby demonstrating their interchangeability.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 39450, 39479, 39481, 39520, 39523, 39524, 39525, 39527, 39528, 39550, 39551, 39552, 39555, 39556, 39579, 39582, 39583, 39584, 39585, 39586, 39587, 39588, 39589, 39590, 39591, 39594, 39595, 39600, 39601, 39605, 39868, 39885

39485 (EPRI-NP—340) **Oconee Nuclear Station Unit One. Cycle two refueling shutdown, primary system radiation levels. Final report.** Chulick, E.T. (Babcock and Wilcox Co., Lynchburg, Va. (USA)). Apr 1977. 71p. P 04/MF A01.

Detailed radiation field mappings were conducted around the equipment associated with the primary coolant system at three stations using Babcock and Wilcox nuclear steam supply systems: Oconee 1 and Oconee 2 operated by Duke Power Company and Three Mile Island 1 operated by Metropolitan Edison Company. Radiation fields at Oconee 1 measured at the second refueling shutdown were comparable to other PWRs of similar age. But fields at Oconee 2 and Three Mile Island 1 at this first refueling shutdown were lower than at plants of comparable ages, most significantly at the once-through steam generator tube sheets. In addition to the radiation field measurements, the significant radioisotopes present in aqueous samples taken from the fuel transfer canals and the reactor coolant systems were identified. Corrosion products were identified as the principal source of radiation fields for the primary coolant system.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 39568, 39573, 39873

39486 (LA-NUREG—6635) **Thermodynamic data for selected gas impurities in the primary coolant of high-temperature gas-cooled reactors.** Feber, R.C. (Los Alamos Scientific Lab., N.Mex. (USA)). Dec 1976. Contract W-7405-ENG-36. 27p. P 03/MF A01.

The literature of thermodynamic data for selected fission-product species is reviewed and supplemented in support of complex chemical equilibrium calculations applied to fission-product distributions in the primary coolant of high-temperature gas-cooled reactors. Thermodynamic functions and heats and free energies of formation are calculated and tabulated to 3000°K for CsI (s,l,g), Cs_2I_2(g), CH_3I(g), COI_2(g), and CsH(g). 79 references.

39487 (ORNL—5188) **Distribution of radionuclides in the Peach Bottom HTGR primary circuit during Core 2 operation.** Dyer, F.F.; Wichner, R.P.; Martin, W.J.; de Nordwall, H.J. (Oak Ridge National Lab., Tenn. (USA)). Mar 1977. Contract W-7405-ENG-26. 179p. P 09/MF A01.

A series of measurements regarding the distribution and levels of radioactivity in the primary circuit of the Peach Bottom HTGR was undertaken throughout the course of Core 2 operation, from July 1970, to final shutdown in October 1974. Four types of observations were conducted in this phase of the Peach Bottom Surveillance Program: (1) the cold duct of the primary circuit was axially scanned for gamma-emitting nuclides on four occasions, including the last which directly followed the final shutdown, (2) the primary coolant was sampled upstream and downstream from the steam generator through diffusion tubes and filters to differentiate between gaseous- and particulate-borne activity, (3) the primary coolant and fuel-element purge flow were rapidly sampled for fission gas measurement, and (4) dust samples collected using the cyclone separators in the primary loop were examined for size distribution, chemical makeup, and contained activity. The various measurements undertaken are described, and the results are presented in tabular and graphical form. Sufficient documentation of experimental procedures is provided to allow continued analyses of primary circuit fission-product distributions to be performed.

39488 (TID—3339-S1) **Gas-cooled reactor technology. A bibliography.** Rushing, J.W. (comp.). (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Feb 1977. 436p. Dep. NTIS $11.75.

Included are 2940 citations to information on gas cooled reactor technology abstracted in Nuclear Science Abstracts Volumes 28 (July 1973) through 33 (June 1976). Corporate, personal author, report number/availability, and subject indexes are provided.

39489 **Small reactors + helium turbines = near-term energy savings.** Keller, C. (Escher Wyss, Zurich, Switz). *Mech. Eng.;* **98**: No. 9, 45-47(Sep 1976).

Many situations call for power and heat generation on a modest rather than a massive scale. High-temperature reactors with closed-cycle helium turbines in a direct cycle could provide cost savings and improved use of fuel through utilization of the waste heat from medium-sized plants. When waste heat is not used, it can be handled by dry-cooling towers which are very small due to the high temperature difference between the cooling water of the gas turbine cycle and the ambient air.

39490 **Studies and thoughts about nuclear systems.** Grenon, M. *Rev. Energ.;* **27**: No. 288, 541-548(Nov 1976). (In French).

The article considers the question of whether there is a place for an intermediate system between the two systems increasingly adopted throughout the world, namely, between the Light Water Reactor (LWR) system and the Liquid Metal Fast Breeder Reactors (LMFBR), and if there is, then for which one. A number of possible alternatives are presented, namely the HTGR, MSBR, CANDU, LWBR, GCFR reactor types and their advantages and disadvantages are compared relying on a study carried out by the Battelle Institue.

39491 **Method of making fissionable-fuel and fertile breeder materials for nuclear reactors.** Foerthmann, R.; Hamesch, M.; Nickel, H. (to Kernforschungsanlage Juelich Gesellschaft mit beschrankter Haftung). US Patent 4,006,096. 1 Feb 1977. Priority date 24 Dec 1970, German, Federal Republic of (F.R. Germany). 4p.

Fissionable fuels and/or fertile breeder materials for nuclear reactors are described which are comprised of fissionable or potentially fissionable materials having evenly distributed throughout certain metal oxides, such as aluminium oxide and niobium oxide, exhibiting the capacity to retain products formed by nuclear fission as stable, nonvolatible compounds in the nuclear material. The fuel element is combined with an effective amount of oxide that is relatively nonvolatile, has a low neutron-capture cross-section and forms such stable, nonvolatile compounds with the solid products resulting from nuclear fission.

39492 **Dual turbine power plant and method of operating such plant, especially one having an HTGR steam supply.** Braytenbah, A.S.; Jaegtnes, K.O. (to Westinghouse Electric Corp.). US Patent 4,007,596. 15 Feb 1977. Filed date 24 Apr 1975. 36p.

A power plant including dual steam turbine-generators connected to pass superheat and reheat steam from a steam generator which derives heat from the coolant gas of a high temperature gas-cooled nuclear reactor is described. Associated with each turbine is a bypass line to conduct superheat steam in parallel with a high pressure turbine portion, and a bypass line to conduct superheat steam in parallel with a lower pressure turbine portion. Auxiliary steam turbines pass a portion of the steam flow to the reheater of the steam generator and drive gas blowers which circulate the coolant gas through the reactor and the steam source. Apparatus and method are disclosed for loading or unloading a turbine-generator while the other produces a steady power output. During such loading or unloading, the steam flows through the turbine portions are coordinated with the steam flows through the bypass lines for protection of the steam generator, and the pressure of reheated steam is regulated for improved performance of the gas blowers. 33 claims, 5 figures

39493 **Dual turbine power plant and a reheat steam bypass flow control system for use therein.** Braytenbah, A.S.; Jaegtnes, K.O. (to Westinghouse Electric Corp.). US Patent 4,007,595. 15 Feb 1977. Filed date 30 Sep 1975. 20p.

An electric power plant having dual turbine-generators connected to a steam source that includes a high temperature gas cooled nuclear reactor is described. Each turbine comprises a high pressure portion operated by superheat steam and an intermediate-low pressure portion operated by reheat steam; a bypass line is connected across each turbine portion to permit a desired minimum flow of steam from the source at times when the combined flow of steam through the turbine is less than the minimum. Coolant gas is propelled through the reactor by a circulator which is driven by an auxiliary turbine which uses steam exhausted from the high pressure portions and their bypass lines. The pressure of the reheat steam is

controlled by a single proportional-plus-integral controller which governs the steam flow through the bypass lines associated with the intermediate-low pressure portions. At times when the controller is not in use its output signal is limited to a value that permits an unbiased response when pressure control is resumed, as in event of a turbine trip. 25 claims, 2 figures

39494 Power plant and system for accelerating a cross compound turbine in such plant, especially one having an HTGR steam supply. Jaegtnes, K.O.; Braytenbah, A.S. (to Westinghouse Electric Corp.). US Patent 4,007,597. 15 Feb 1977. Filed date 30 Sep 1975. 14p.

An electric power plant having a cross compound steam turbine and a steam source that includes a high temperature gas-cooled nuclear reactor is described. The steam turbine includes high and intermediate-pressure portions which drive a first generating means, and a low-pressure portion which drives a second generating means. The steam source supplies superheat steam to the high-pressure turbine portion, and an associated bypass permits the superheat steam to flow from the source to the exhaust of the high-pressure portion. The intermediate and low-pressure portions use reheat steam; an associated bypass permits reheat steam to flow from the source to the low-pressure exhaust. An auxiliary turbine driven by steam exhausted from the high-pressure portion and its bypass drives a gas blower to propel the coolant gas through the reactor. While the bypass flow of reheat steam is varied to maintain an elevated pressure of reheat steam upon its discharge from the source, both the first and second generating means and their associated turbines are accelerated initially by admitting steam to the intermediate and low-pressure portions. The electrical speed of the second generating means is equalized with that of the first generating means, whereupon the generating means are connected and acceleration proceeds under control of the flow through the high-pressure portion. 29 claims, 2 figures.

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

REFER ALSO TO CITATION(S) 39490

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 39490, 39549, 39554, 39571, 39574, 39575, 39577, 39592, 39596, 39598, 39599, 39604, 39848, 39869, 39872, 39884

39495 (AI-ERDA—13192) **Sodium technology: the reaction rates of sodium with alcohols.** Welch, F.H.; Steele, O.P. III. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Feb 1977. Contract EY-76-C-03-0824. 80p. AT.

Significant testing has been conducted on the reaction rate of sodium with various alcohols, as a part of the Sodium Removal Task of the Sodium Technology Program. The test variables included: (1) test temperature, (2) water content, (3) sodium sample form and location, (4) sodium sample attitude, and (5) acid additions. An anhydrous, fully denatured ethanol was selected as the optimum solution for the removal of sodium from liquid metal fast breeder reactor (LMFBR) components, based on the data reported and from supporting studies. The addition of 1.5 vol. percent acetic acid and 0.5 vol. percent water (maximum) to the alcohol was recommended as an alternate sodium removal solution, to eliminate the presence of caustic residues in those conditions, permitting its use.

39496 (ANL—77-2) **Generalized parametric model for transient gas release and swelling in oxide fuels.** Gruber, E.E. (Argonne National Lab., Ill. (USA)). Jan 1977. Contract W-31-109-ENG-38. 47p. AT.

A detailed mechanistic analysis is presented for intragranular swelling and release of gas from grains to grain boundaries, both as they result from transient heating. A generalized parametric model to approximate the results that would be obtained from the more detailed calculations is also described. The need for this model arises from the necessity to consider the fission-gas effects in more general multinode accident-analysis and pin-mechanics codes. For such calculations, the more detailed Fission-gas Release And Swelling (FRAS) code is prohibitive in its demands on computer storage and execution time, while the Parametric FRAS (PFRAS) code reduces these demands by an order of magnitude. Examples of results of transient calculations are shown for the two codes, both to illustrate the sensitivity of the results to the parameters, and to indicate the level of confidence that can reasonably be ascribed to PFRAS results.

39497 (ANL-LEO-TR—76-2) **Liquid Metal Fast Breeder Reactor Program: Argonne facilities.** Stephens, S.V. (comp.). (Argonne National Lab., Ill. (USA)). Sep 1976. Contract W-31-109-ENG-38. 94p. P 05/MF A01.

The objective of the document is to present in one volume an overview of the Argonne National Laboratory test facilities involved in the conduct of the national LMFBR research and development program. Existing facilities and those under construction or authorized as of September 1976 are described. Each profile presents brief descriptions of the overall facility and its test area and data relating to its experimental and testing capability. The volume is divided into two sections: Argonne-East and Argonne-West. Introductory material for each section includes site and facility maps. The profiles are arranged alphabetically by title according to their respective locations at Argonne-East or Argonne-West. A glossary of acronyms and letter designations in common usage to describe organizations, reactor and test facilities, components, etc., involved in the LMFBR program is appended.

39498 (COO—2250-24) **MIT LMFBR blanket research project. Quarterly progress report, October 1, 1976—December 31, 1976.** Driscoll, M.J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1976. Contract EY-76-S-02-2550.A001. 13p. Dep. NTIS $3.50.

Progress in the experimental and theoretical investigation of LMFBR breeding blanket design parameters is reported.

39499 (CRBRP-ARD—0034) **Clinch River Breeder Reactor Plant. Heat transfer correlation for analysis of CRBRP assemblies.** Kazimi, M.S.; Carelli, M.D. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Nov 1976. Contract EY-76-C-15-0003;EY-76-C-15-2395. 19p. AT.

An investigation was performed to assess the adequacy of the correlations currently used to describe the heat transfer coefficient to sodium flowing in CRBRP assemblies in light of the experimental data acquired after 1968. The available experimental data for bundles with P/D ratios of 1.05 to 1.3 and the relevant heat transfer correlations are described. Correlations for CRBR fuel, radial blanket and control assemblies are recommended.

39500 (CRBRP-ARD—0106(Vol.1)) **Clinch River Breeder Reactor Plant. VARR II: a computer program for calculating time dependent turbulent fluid flows with slight density variation.** Cook, J.L.; Nakayama, P.I. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Nov 1976. Contract E(49-18)-12-3;E(11-1)-2395. 162p. AT.

A numerical method capable of computing time dependent turbulent fluid flows with small density variations has been incorporated in the VARR II computer code. This code allows for a variety of initial and boundary conditions as well as arbitrarily placed internal obstacles, and inlet and exit conditions. In addition, several techniques for treating the convective and diffusive fluxes have been built into VARR II so that the user may select the one most suited to the needs of a particular problem configuration.

39501 (CRBRP-ARD—0108) **Clinch River Breeder Reactor Plant. 11:1 scale wire wrapped rod bundle air flow tests. Interior subchannels.** Bartholet, T.G.; Roidt, R.M.; Harper, L.J. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Jan 1977. Contract EY-76-C-15-0003;EY-76-C-15-2395. 156p. AT.

Experimental work conducted with the 10.87 to 1 scale air flow test facility at the Westinghouse Research Laboratories is described. The purpose is to obtain new data for subchannel analysis code developers to improve the accuracy of their calculational techiques for wire wrapped rod bundles. The large scale rod bundle offers a unique opportunity to make detailed measurements of mixing and flow behavior within the rod bundle. The experimental results described here cover identification of flow development characteristics, tracer gas mixing tests, gap crossflow determination, and detailed axial flow measurements for interior subchannels of a wire wrapped rod bundle.

39502 (CRBRP-ARD—0154) **Clinch River Breeder Reactor Plant. 11:1 scale wire wrapped rod bundle air flow test, corner subchannel.** Bartholet, T.G.; Roidt, R.M.; Romano, J.E. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Jan 1977. Contract EY-76-C-15-0003;EY-76-C-15-2395. 102p. AT.

Experimental work conducted with the 10.87 to 1 scale air flow test facility is described. The test assembly itself is an unheated 10.87:1 scale model of a portion of a Clinch River Breeder Reactor fuel assembly. As such, it offers a unique opportunity to make detailed measurements of mixing and flow behavior within the rod bundle. The experimental results described cover identification of flow development characteristics, tracer gas mixing tests, gap crossflow mappings, and detailed axial flow measurements for the corner subchannel region of the test assembly.

39503 (CRBRP-ARD—0157) **Clinch River Breeder Reactor Plant. Preliminary flow management distribution.** Marinkovich, P.S.

(Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Nov 1976. Contract EY-76-C-15-0003;EY-76-C-15-2395. 28p. AT.

The Clinch River Breeder Reactor Plant current flow-pressure drop characteristics within the reactor vessel and the core orificing requirements to achieve the desired flow distribution and reactor system flow are described. Based on current design and test information the reactor vessel nominal pressure drop is predicted to be 105 psi with a maximum predicted value of 122.7 psi at the thermal-hydraulic design flow of 41.446 x 10^6 lb/hr. This is within the design pressure drop allowance of 123 psi for this flow rate. The Removable Radial Shield flow allocation of 3.0 percent reported in the PSAR has been reduced to 1.5 percent with the excess 1.5 percent flow redistributed as follows: 0.8 percent to the fuel assemblies, 0.5 percent to the radial blanket assemblies and 0.2 percent to the control assemblies. This information is considered Supporting Design Data, and as such should not be baselined: however, it will be continually updated throught the final design stage, as experimental data become available from the hydraulic test program, or if the Alternate Fuel Management Scheme (AFMS) core becomes the reference core design.

39504 (CRBRP-ARD—0160) **Clinch River Breeder Reactor Plant. 11:1 scale wire wrapped rod bundle air flow test, hot film anemometer experiments.** Bartholet, R.G.; Roidt, R.M.; Romano, J.E. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Jan 1977. Contract EY-76-C-15-0003;EY-76-C-15-2395. 46p. AT.

Results of turbulence measurements within the interior subchannels using a hot film anemometer are reported. The test assembly is an unheated 10.87 to 1 scale model of a portion of a Clinch River Breeder Reactor fuel assembly. As such, it offers an opportunity to make turbulence measurements within the wire wrapped rod bundle. The turbulent intensity, Eulerian time scale and scalar eddy diffusivity have been determined in the interior subchannels surrounding a wire wrapped rod at five different axial locations. Details of the test assembly, instrumentation and signal processing equipment, data reduction methods and test results are presented.

39505 (IWGFR—14) **LMFBR plant parameters.** (International Atomic Energy Agency, Vienna (Austria). International Working Group on Fast Reactors). Dec 1976. 18p. U 02/MF A01.

The document contains up-to-date data on existing or firmly decided prototype or demonstration LMFBR reactors, on planned commercial size LMFBR according to the present status of design, and on experimental fast reactors such as BOR-60, DFR, EBR-II, FERMI, FFTF, JOYO, KNK-II, PEC, and RAPSODIE-FORTISSIMO. Only corrected and revised parameters submitted by the countries participating in the IWGFR are included in the document.

39506 (SAND—76-0721) **Evaluation of design safety factors for time-dependent buckling.** Stone, C.M.; Nickell, R.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). Feb 1977. Contract EY-76-C-04-0789. 30p. (NUREG—0179). P 03/MF A01.

The ASME Boiler and Pressure Vessel Code rules concerning time-dependent (creep) buckling for Class 1 nuclear components have recently been changed. Previous requirements for a factor of ten on service life have been replaced with a factor of safety of 1.5 on loading for load-controlled buckling. This report examines the supposed equivalence of the two rules from the standpoint of materials behavior—specifically, the secondary creep strain rate exponent. The comparison is made using results obtained numerically for an axially-loaded, cylindrical shell with varying secondary creep exponents. A computationally efficient scheme for analyzing creep buckling problems is also presented.

39507 (WARD-HT—3045-20) **Validation of high temperature design methods and criteria. Quarterly progress report for period ending February 29, 1976.** Bishop, E.C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Nov 1976. Contract EY-76-02-3045-006. 169p. AT.

Progress is reported in the testing and analysis of stainless steel-304 and stainless steel-316 plates and tubular specimens for FFTF and LMFBR pressure-containing components. Included are sections on basic specimen testing, tubular specimen testing, structure testing, FFTF/IHX inlet nozzle testing, analysis methods and procedures, and crack propagation testing. (DG)

39508 (WARD-HT—3045-22) **Validation of high temperature design methods and criteria. Quarterly progress report for period ending August 31, 1976.** Bishop, E.C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 31 Aug 1976. Contract EY-76-C-02-3045-006. 100p. AT.

Information on materials testing for LMFBR type reactors is presented concerning stress testing of 304 and 316 stainless steels, buckling test of an FFTF elbow, and testing of FFTF intermediate heat exchanger inlet nozzle.

39509 (WARD-HT—3045-23) **High temperature structural design technology: validation. Quarterly progress report for the period ending November 30, 1976.** Bishop, E.C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 30 Nov 1976. Contract EY-76-C-02-3045-006. 111p. AT.

Information on materials testing for LMFBR type reactors is presented concerning stress testing of 304 and 316 stainless steels, collapse testing of a 16 inch FFTF elbow, thermal stress testing of FFTF intermediate heat exchanger inlet nozzle, and rupture testing of CRBRP pipe sections.

39510 (WARD-RB—3045-15) **Radial blanket design and development. Quarterly progress report for period ending August 31, 1976.** Bishop, E.C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Jan 1977. Contract EY-76-C-03-3045-004. vp. AT.

Summaries of prior work and current progress are presented for the following LMFBR task areas: (1) radial blanket assembly heat transfer testing, (2) radial blanket assembly irradiation testing, (3) radial blanket flow orificing test, and (4) radial blanket rod bundle compaction tests. (DG)

39511 (WARD-RB—3045-16) **Radial blanket design and development. Quarterly progress report for period ending November 30, 1976.** Bishop, E.C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Feb 1977. Contract EY-76-C-02-3045-004. 70p. AT.

A series of zero power shakedown tests were completed for the radial blanket assembly heat transfer test facility. These tests provided base-line data on system temperatures, heat losses and sodium flow, flow split and pressure drop relationships for the "new" system. A comparison was made between predictions made using Novendstern's correlation for wire wrapped bundles and the measured ΔP for the 61-rod bundle. The radial blanket seven-rod irradiation test (WBA-20) in EBR-II accumulated peak fluence into run 85 was 7.3 x 10^{22} n/cm^2 (E greater than 0.1 MeV). Analysis of the scheduled power jump for this assembly indicates that the stresses produced in the cladding as a result of the power increase could exceed the yield strength. Consequently, a reassessment of the magnitude of the power jump for WBA-20 has been initiated. Design of a second EBR-II blanket irradiation test continued. Performance predictions for the blanket assembly test in FTR (WBA-40) were made using recent information received from HEDL. An interim report describing the orifice calibration tests and results was prepared and is scheduled for release in January 1977. Additional orifice assemblies are being designed to meet requirements for new tests identified as a result of recent CRBRP LIM design changes. The LIM Test model drawings are also being changed to reflect the CRBRP changes. The pneumatic cylinders required to minimize hysteresis in the load pad actuator system of the radial blanket bundle compaction test facility were received. The cylinders are being modified for use on the compaction test rig.

39512 (WARD-RB—3045-17) **Radial blanket design and development. Quarterly progress report for period ending February 28, 1977.** Bishop, E.C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Mar 1977. Contract EY-76-C-02-3045-004. 63p. AT.

A series of zero power shakedown tests were completed for the radial blanket assembly heat transfer test. These tests provided base-line data on system temperatures, heat losses and sodium flow, flow split and pressure drop relationships for the "new" system. A second series of pressure drop versus flow data for the heat transfer bundle was obtained. A comparison was made between predictions made using Novendstern's correlation for wire wrapped bundles and the measured ΔP for the 61-rod bundle. In the turbulent region, the pressure drop versus flow plot had the same slope as the predictions, but was somewhat lower than the prediction. Friction factor correlations were obtained which show good correlations with data from wire-wrapped fuel assemblies. The WBA-40 drawings for the radial blanket irradiation test, revised to cover FFTF interfaces, were checked and distributed for internal review in preparation for a formal design review meeting. The effort to evaluate the effect of the six surrounding assemblies on the temperature distribution of the WBA-40 rod bundle was completed. Design changes are being made in the orifice assemblies and lower inlet module model to reflect recent changes in the CRBRP-LIM. Assembly, checkout and calibration of the radial blanket bundle compaction test rig were completed. Preliminary force versus displacement data were obtained for compaction of the mock-up bundle. Drawings for the prototypic bundle were completed and fabrication of some components was started.

39513 (WARD-SD—3045-2) **High temperature structural design technology: application. Quarterly progress report for period ending November 30, 1976.** Griffin, D.S. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Jan 1977. Contract EY-76-C-02-3045-032. vp. AT.

Progress is summarized in a program to provide the LMFBR structural designer with qualified analysis methods, design procedures, design limits and criteria, and the guidance required for

proper application to assure adequate evaluation and assessment of FFTF operational experience; safe and reliable structural design of CRBR, PLBR, and large component test facilities; an ' development of the structural design technology necessary for successful commercialization of the LMFBR. The program includes the following tasks: design criteria and standards; simplified inelastic analysis methods; computer program validation, implementation, and distribution; and piping integrity. (DG)

39514 Comparative analysis of the economic characteristics of closed-cycle gas turbine installations with fast neutron reactors. Gribovskii, V.P.; Klok, A.M.; Tetel'baum, S.D. (Odessa Polytechnic Inst.). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 7, 84-89(1976). (In Ukrainian).

In view of the fact that the literature on combinations of closed-cycle gas turbines and fast neutron reactors deals only with the efficiency of certain parts (e.g., heat exchangers) of the turbine, the authors present information on their attempts to estimate the influence of the thermophysical properties of working media on the comparative cost indices of such installations. For each of the working media (helium, carbon dioxide, and mixtures of the two) an optimum range of variation of reactor characteristics was selected from the point of view of power station efficiency. For example, for a given nuclear power station configuration it is economically advantageous to use carbon dioxide as the working medium at q/sup max/ 6 Mw/m² and T/sup max/ 1,140 K. Helium is efficient in the range of variation q/sup max/ = 2 — 6 Mw/m², but only with much higher temperatures (1,700 K and above). For currently permissible fuel cell casing temperatures of 1,000 to 1,200 K and reactor core heat load of 2 to 3 Mw/m² the most effective working medium for power station efficiency is a mixture of certain heavy gases with helium.

39515 (EURFNR—1339) **FR-2 capsule experimental group 5b, design, irradiation and post-irradiation examination of the UO_2/PuO_2 test fuel pins.** Weimar, P.; Freund, D.; Steiner, H. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). Feb 1976. Translation of KFK—2222. 216p. P 10/MF A01.

Work performed under United States—Euratom Fast Reactor Exchange Program.

The experiment capsule group FR2-Vg5b comprises 18 short pins which are irradiated in a special irradiation capsule. The fuel was mixed oxide with a Pu content of 35 wt percent. With a pellet density of 86.2 percent, the smear density was 80 percent of th. density. As cladding material an austenitic steel No. 1.4988 was chosen. The pin diameter was 4.7 mm, the wall thickness was 0.3 mm, and 12 pins were irradiated up to a burnup of 10 at. percent and 6 up to 1 and 2 at. percent, respectively. All pins remained intact. The radiographs of the pins showed strong irregularities in the contour of the central channel. The ceramographic investigation showed a U-Pu redistribution and a strong densification at the pellet periphery. A detailed description of design, specification and fabrication of the pins, the irradiation history and the post irradiation examination is presented. Thermal and mechanical aspects of the fuel pin behavior have been analyzed by means of the program system SATURN 1.

39516 (EURFNR—1346) **Determination of various metallic and nonmetallic impurities in sodium metal.** Schneider, H.; Gruenhaeuser, M.; Nagel, G.; Nold, E.; Schaefer, A.; Schumann, H. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). Apr 1976. Translation of KFK—2267. 44p. P 03/MF A01.

Work performed under United States—Euratom Fast Reactor Exchange Program.

Methods for the determination of various metallic and nonmetallic impurities in sodium metal were developed respectively tested. Detection limits, reproducibilities and results of analyses are reported.

39517 (EURFNR—1378) **Creep of fuel pin clads in the breeder reactor at a high temperature under internal and external pressure. Development of a theoretical model and of a method for the continuous measurement of deformation.** Krugmann, U. (Kernforschungszentrum Karlsruhe (Germany, F.R.)). Aug 1976. Translation of KFK—2336. 178p. P 09/MF A01.

Thesis. Submitted to Technische Univ. Darmstadt (F.R. Germany). Work performed under United States—Euratom Fast Reactor Exchange Program.

A theoretical model is developed for the analytical description of creeping of fuel element cladding tubes. The cladding tube is treated as a shell. The creep law of Norton is valid. A capacitive measuring system is developed for the continuous measurement of creep deformation of cladding tubes subjected to temperatures up to 700°C and internal or else external pressure. The measuring system is presented with particular regard to the measuring accuracy. Out-of-pile creep experiments on cladding tubes of fast breeder reactors are reported, which have been performed by the capacitive measuring system and analyzed by the shell model. The results are compared to creep data of other authors obtained on identical cladding tubes by different measuring systems.

39518 (ANL-Trans—1079) **Sodium pumping: pump problems.** Guer, M.; Guiton, P. (Caen Univ., 14 (France)). Dec 1976. Translation of FRNC-CONF—44. (CONF-720648—26). 10p. P 02/MF A01.

From 12. meeting on hydraulics; Paris, France (6 Jun 1972).

Information on sodium pumps for LMFBR type reactors is presented concerning ring pump design, pool reactor pump design, secondary pumps, sodium bearings, swivel joints of the oscillating annulus, and thermal shock loads.

39519 Method of making self-calibrated displacement measurements. Pedersen, H.N. (to Westinghouse Electric Corp.). US Patent 4,008,455. 15 Feb 1977. Filed date 24 Feb 1975. 6p.

A method for monitoring the displacement of an object having an acoustically reflective surface at least partially submerged in an acoustically conductive medium is described. The reflective surface is designed to have a stepped interface responsive to an incident acoustic pulse to provide separate discrete reflected pulses to a receiving transducer. The difference in the time of flight of the reflected acoustic signals corresponds to the known step height and the time of travel of the signals to the receiving transducer provides a measure of the displacement of the object. Accordingly, the reference step length enables simultaneous calibration of each displacement measurement. 3 claims, 3 figures

POWER REACTORS, AUXILIARY, MOBILE, PACKAGE, AND TRANSPORTABLE

REFER ALSO TO CITATION(S) 39570

REGULATION AND LICENSING

REFER ALSO TO CITATION(S) 39570

39520 (DOCKET-50213—673) **Haddam Neck Plant. Annual operating report: January—December 1976.** (Connecticut Yankee Atomic Power Co., Hartford (USA)). 1 Mar 1976. 58p.

Net electric power generated was 4,026,168.66 MWH with the reactor on line 7,248.60 hrs. Information is presented concerning operations, design changes, start-up physics testing, steam generator eddy current examination, corrective maintenance, shutdowns and power reductions, coolant chemistry, personnel radiation exposure, power generation and fuel performance. (FS)

39521 (DOCKET-50259—971) **Browns Ferry Nuclear Power Station, Units 1, 2, and 3. Annual operating report: January—December 1976.** (Tennessee Valley Authority, Chattanooga (USA)). 1977. 101p. (DOCKET-50260—739; DOCKET-50296—431).

Units 1 and 2 were down for the first half of the year caused by the fire of March 1975. Net electrical power generated by Unit 1 this year was 1,301,183 MWH with the generator on line 2,175.25 hrs. Unit 2 generated 1,567,170 MWH with the generator on line 2,548.73 hrs. Unit 3 began full power operation on November 20th and generated 1,416,891 MWH with the generator on line 2,058.20 hrs. Information is presented concerning operations, fuel performance, surveillance testing, containment leak testing, changes, power generation, shutdown and forced reductions, coolant chemistry, occupational radiation exposures, and maintenance. (FS)

39522 (DOCKET-50263—811) **Monticello Nuclear Generating Plant, Unit 1. Annual operating report No. 11: January—December 1976.** (Northern States Power Co., Minneapolis, Minn. (USA)). 28 Feb 1977. 34p.

Information is presented concerning operation, outages, forced power reductions, occupational radiation exposures, fuel performance, maintenance, changes, tests, and experiments. (FS)

39523 (DOCKET-50272—395) **Salem Nuclear Generating Station, Unit 1. Annual operating report for 1976.** (Public Service Electric and Gas Co., Newark, N.J. (USA)). 28 Feb 1977. 108p.

Initial reactor criticality was achieved 12/11/76 and power generation began 12/25/76. Information is presented concerning operation, maintenance, procedure and specification changes, power generation, unit shutdowns and forced power reductions, testing, and personnel radiation exposures. (FS)

39524 (DOCKET-50282—701) **Prairie Island Nuclear Generating Plant, Units 1 and 2. Annual operating report No. 6 for 1976.** (Northern States Power Co., Minneapolis, Minn. (USA)). 25 Feb 1977. 46p. (DOCKET-50306—568).

Information is presented concerning operating experience, outages and forced power reductions, personnel radiation exposures, fuel performance, changes, tests, experiments, and maintenance. (FS)

39525 (DOCKET-50289—856) **Three Mile Island Nuclear Station, Unit 1. 1976 annual operating report.** (Metropolitan Edison Co., Reading, Pa. (USA)). 28 Feb 1977. 60p.

Net electrical power generated was 4,335,625 MWh with the reactor on line 5,747.5 hrs. Information is presented concerning operations; specification, procedures, and FSAR changes; corrective maintenance; irradiated fuel examinations; radioactive effluent releases; personnel radiation exposures; shutdowns; and forced power reductions. (FS)

39526 (DOCKET-50293—806) **Pilgrim Nuclear Power Station, Unit 1. Annual operating report for 1976.** (Boston Edison Co., Mass. (USA)). [nd]. 54p.

Net electrical power generated was 2,415,511 MWH with the generator on line 5,333.6 hrs. Information is presented concerning operations, procedure changes, tests, experiments, maintenance, unit shutdowns and power reductions, and radiation doses to personnel. (FS)

39527 (DOCKET-50305—577) **Kewaunee Nuclear Power Plant, Unit 1. Annual operating report: January—December 1976.** (Wisconsin Public Service Corp., Green Bay (USA)). 28 Feb 1977. 131p.

Net electrical power generated was 3,383,265.0 MWh with the generator on line for 6,926.8 hrs. Information is presented concerning operations, power generation, changes in technical specifications, modifications, steam generator tube inspection, containment leak rate tests, in-service inspection, maintenance, environmental technical specifications, and the radiological monitoring program. (FS)

39528 (DOCKET-50315—720) **Donald C. Cook Nuclear Power Plant, Unit 1. Annual operating report for 1976.** (Indiana and Michigan Power Co., New York (USA)). 28 Feb 1977. 78p.

The unit was paralleled to the grid 83.1 percent of the time and 7,073,200 MWH gross was generated. There were six scheduled outages and 14 forced outages/load reductions. Information is presented concerning operations, shutdowns, power reductions, inservice maintenance, personnel radiation exposures, fuel history, and facility changes. (FS)

39529 (NTISUB/B—124-76/008) **Monthly inspection summary report.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Inspection and Enforcement). Aug 1976. 77p. (NUREG—0025-8). Q 05/MF A01.

See also NTISUB/B—124-76/007.

The scope and findings of inspections and investigations made by the Nuclear Regulatory Commission (NRC) are summarized in a monthly report. These include NRC reports on nuclear power reactors under construction or in operation. Information on individual facilities is presented, including such items as non-compliance with regulations, abnormal occurrence reviews, plant status and, for plants under construction, implementation of quality assurance audits. (GRA)

39530 (NUREG—0207(Draft)) **Interim format and content for a physical security plan for nuclear power plants.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Nuclear Reactor Regulation). Feb 1977. 50p. P 03/MF A01.

The document serves as interim guidance to assist the licensee or applicant in the preparation of a physical security plan. It is to be used in conjunction with interim acceptance criteria for physical security programs, which will be distributed at a later date.

39531 (RDT-STATUS—4-77) **RDT standards. Status report.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Reactor Development and Demonstration). Apr 1977. Contract W-7405-ENG-26. 36p. RSO.

39532 (NP-tr—1970) **Decommissioning of nuclear power stations.** Brosche, D.; Essmann, J. Translated from *At. Strom;* **22**: No. 3, 81-87(1976). 26p. U 03/MF A01.

The Federal Government requires in the safety criteria proof of the possibility of decommissioning of nuclear power stations. The electricity supply undertakings have considered this question in the context of a study undertaken by the VDEW and have been able to show that nuclear power stations, on conclusion of their operating life, can be decommissioned for a reasonable technical outlay.

39533 **Human cost of regulatory delays.** Burnett, T.W.T. (Westinghouse Electric Corp., Pittsburgh). *Nucl. Technol.;* **33**: No. 2, 203-211(Apr 1977).

The pursuit of perfection, inherent in the nuclear regulatory process and escalating licensing requirements, is extremely costly-not only in terms of dollars, but also in terms of public health and safety. One month's delay of a single 1000-MW(e) [1-GW(e)] nuclear station can lead to 38,000 equivalent person-days of illness if the replacement electricity is generated equally by oil and coal-fired stations representative of current practice. This cost exceeds, by a factor of approximately 10, the public health and safety risk imposed by possible nuclear meltdown accidents over the entire 40-yr life of a nuclear plant, as assessed by the Reactor Safety Study, WASH-1400. The responsibility of the nuclear regulator is to attempt to minimize nuclear risk through ever-increasing regulatory requirements. It is not his job to be reasonable, or to worry about economics, or to be concerned about adverse health and safety effects caused by alternatives to nuclear power. Therefore, it is the societal obligation of the nuclear industry to oppose unreasonable regulatory demands.

ECONOMICS

39534 (BNL—50563) **Optimization of water conveyance systems for nuclear energy centers.** Meier, P.M. (Brookhaven National Lab., Upton, N.Y. (USA)). Sep 1976. Contract EY-76-C-02-0016. 87p. P 05/MF A01.

The report develops a mathematical model for the conceptual design of water supply systems for nuclear energy centers based on a classical optimization analysis under inequality constraints and an embedded enumeration scheme. A hypothetical nuclear energy center in New Jersey is used for illustrative computations and sensitivity analysis to major design variables. The optimization criterion is the minimization of present worth over the lifespan of the center, and encompasses all major components of the cooling, water conveyance and heat dissipation systems. Analysis of the trade-off between electric transmission and water conveyance, and comparisons of cooling system modes are also included.

CONSTRUCTION AND OPERATION

REFER ALSO TO CITATION(S) 39483

FUEL CYCLE

REFER ALSO TO CITATION(S) 39308, 39309, 39310, 39311, 39314

39535 (ORNL/TM—5703) **Survey of nuclear fuel cycle economics: 1970—1985.** Prince, B.E.; Peerenboom, J.P.; Delene, J.G. (Oak Ridge National Lab., Tenn. (USA)). Mar 1977. Contract W-7405-ENG-26. 142p. P 07/MF A01.

This report is intended to provide a coherent view of the diversity of factors that may affect nuclear fuel cycle economics through about 1985. The nuclear fuel cycle was surveyed as to past trends, current problems, and future considerations. Unit costs were projected for each step in the fuel cycle. Nuclear fuel accounting procedures were reviewed; methods of calculating fuel costs were examined; and application was made to Light Water Reactors (LWR) over the next decade. A method conforming to Federal Power Commission accounting procedures and used by utilities to account for backend fuel-cycle costs was described which assigns a zero net salvage value to discharged fuel. LWR fuel cycle costs of from 4 to 6 mills/kWhr (1976 dollars) were estimated for 1985. These are expected to reach 6 to 9 mills/kWr if the effect of inflation is included.

39536 (ERDA-tr—262) **Nuclear fuel requirements for different long-term reactor strategies.** Solanilla, R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1974. Translation of CNEA—375. 27p. P 03/MF A01.

The influence on nuclear fuel consumption due to different long-term power reactor strategies that may be applied in Argentina is evaluated for the coming 30 years.

PROCESS HEAT REACTORS

39537 (PB—255630) **Feasibility study of a nuclear power-sewage treatment system for the conservation and reclamation of water resources. Technical completion report.** Fazzolare, R. (Arizona Univ., Tucson (USA). Dept. of Nuclear Engineering). 1976. Contract DI-14-31-0001-3503. 13p. NTIS $3.50.

Seventy percent of the energy produced in a nuclear power reactor is rejected to the environment as low quality heat. One possible use of this heat source is for domestic wastewater treatment. This study examined a ferric-chloride, powdered activated carbon and an aluminum sulfate, powdered activated carbon physical-chemical system in a one-step process as a function of temperature (20-80 C). COD, suspended solids, turbidity and phosphorus removals were used to monitor performance. Significant improvement in pollutant removals was obtained at higher temperatures with the optimum results occurring between 50 and 60 C. Since urban wastewater flow and electric power usage are population-dependent and the system optimum treatment temperature coincides with waste

heat characteristics, a combined power plant-wastewater system would generate recyclable water. (GRA)

NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 39668

THEORY AND CALCULATION

39538 Assessment of several approximation techniques for nuclear reactor spatial kinetics. Luxat, J.C. (Gellman, Hayward, and Partners Ltd., Toronto). pp 187-194 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976). See CONF-760703—.

The simulation of the kinetic behaviour of the neutron density and distribution in a nuclear power reactor is an important part of any analysis and design study concerned with reactor control and safety systems. The process of selecting the correct technique to fulfill the requirements of a particular application is analysed and a number of general observations are made. A more detailed comparison is made of the two approximation approaches which can potentially yield the greatest cost savings; namely the model and nodal techniques.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 39603, 39865, 39866, 39867

39539 (PB—260554) **Sensor response time verification. Final report.** Foster, C.G.; Krause, J.D.; Stanley, L.; Visse, P.V.; Cain, D.G. (Nuclear Services Corp., Campbell, Calif. (USA)). Oct 1976. 135p. Q 07/MF A01.

The final results of Research Project RP503-1 concerning pressure and differential pressure sensor response time verification are presented. A selected sample of nine typical process sensors have been tested using a specially designed hydraulic signal generator and detailed test procedures to verify their ability to produce valid sensor response time measurements in a simulated in-situ configuration. Design details are provided concerning the hydraulic signal generator, and generic test procedures are included to permit the utility user to quickly implement a response time measurement program for these and other similar sensor types. (GRA)

39540 (ORNL-tr—4333) **Effect of density deviations of concrete on its attenuation efficiency.** Szymendera, L.; Wincel, K.; Blociszewski, S.; Kordyasz, D.; Sobolewska, I. (Institute of Nuclear Research, Warsaw (Poland)). 1975. Translation of INR 1563/IX/PR/B. 18p. P 02/MF A01.

In the work, the influence of concrete density deviation on shield thickness and total dose ratio outside the reactor shield, has—on the basis of numerical analysis—been considered. It has been noticed the possibility of introducing flexible corrections—without additional shielding calculation—to the design thickness of the shield. It has been also found that in common cases of shield design, where any necessity of minimizing the shield thickness does not exist, the tendency to minimize the value of this deviation is hardly substantiable.

39541 Influence of the openings on the deformed state of the reinforced concrete shielding of a nuclear power plant. Mikhaylov, O.V.; Zaytsev, V.N. *Beton Zhelezobeton;* No. 8, 8-11(1976).

The deformed state of the nuclear power plant shielding is considered for the case where the shielding is subjected to an internal pressure in the area of openings that are arranged in a single vertical line and reinforced by a thickening of the wall on one side. The study was conducted on a large-scale model made of ordinary reinforced concrete. It was found that in order to reduce the tensile stresses in the immediate vicinity of the openings to values below those that would lead to outer surface cracks, local thickening of the wall of the shield is required. The dimensions of the rectangular reinforcement should be selected so that its edges are 1.7—2.0 opening diameters from the center of the opening, and the additional thickness of the wall of the shielding should amount to 0.25 opening diameter. In the area of an opening the wall reinforcement must be analogous to that in the smooth area, with the same percentage reinforcement. The design and orientation of the reinforcement used in the experimental model increased the rigidity of the vertical zone of the shielding and caused, along the edges of the zone, a generation of annular bending moments which led to a bending of the zone inward relative to the adjacent zones.

39542 Computer analysis of crack propagation. Yamada, K.; Albrecht, P. (Univ. of Maryland, College Park). pp 286-290 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976). See CONF-760703—.

The objective of the paper is to present a generally accepted model of crack propagation which is based on the fracture mechanics approach to fatigue and to illustrate with selected examples from structural engineering the kind of fatigue life calculations which can be performed. The algorithms employed in the numerical solution of the governing equation are briefly described.

39543 (EURFNR—1356) **Monitoring instrument for the rapid detection of oscillatory components in noise-infested signals.** Ehrhardt, J.; Massier, H. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Mar 1976. Translation of KFK—2159. 55p. P 04/MF A01.

Work performed under United States—Euratom Fast Reactor Exchange Program.

Noise analysis is increasingly used for the development of diagnostic methods to permit the early detection of unusual changes in the measuring signal under examination and therefore in the monitored system. The aim in this case is, by identification of characteristic signals, to allocate these changes to specific causes, so that suitable countermeasures can be taken to prevent a more widescale propagation of the fault. The present report describes the apparatus required for implementation of the monitoring unit, particular emphasis being placed on the fact that the described monitoring technique is applicable, in general, for the recognition of oscillatory interference signals in noise. The model of monitoring unit for the test stage has been designed in as variable a form as possible in order to permit any necessary changes to be easily made.

39544 (PB—258233) **Series on statistical application and methodology on the use of confidence intervals as probability intervals. Statistical report.** Easterling, R.G. (Nuclear Regulatory Commission, Washington, D.C. (USA)). Jun 1976. 17p. (NR/ASG—001). NTIS $3.50.

The practice of using statistical confidence intervals as probability intervals in studies of system uncertainties is examined. In several examples, most of which relate to system reliability analysis, it is shown that this practice can lead to intervals which have almost no chance of containing the quantity of interest and that system failure probabilities may be considerably overestimated. Since appropriate statistical methods for obtaining confidence intervals for system functions are available, it is concluded that the practice of treating confidence intervals as probability intervals can and should be avoided. (GRA)

39545 (PB—258128) **Inspection of nuclear reactor welding by acoustic emission. Data report, Nov 1975—May 1976.** Prine, D.W. (GARD, Inc., Niles, Ill. (USA)). Oct 1976. Contract AT(49-24)-0187. 33p. NTIS $4.00.

Experimental acoustic emission data on simulated nuclear pressure vessel welds are presented. Some analysis of this data is included, however, the analysis is incomplete due to the current unavailability of confirming NDE and metallographic results. (GRA)

FUEL ELEMENTS

REFER ALSO TO CITATION(S) 39852

39546 Nuclear reactor fuel elements. Woodacre, A. (to United Kingdom Atomic Energy Authority). US Patent 4,007,085. 8 Feb 1977. Priority date 21 Jan 1974, United Kingdom of Great Britain and Northern Ireland (UK). 2p.

A nuclear reactor fuel element has within its protective sheath an insert whereby it may be uniquely identified. The insert bears an array of markings at spaced positions to produce a series of clock pulses on presentation of the insert to a detector responsive to each marking and further markings at only some of the spaced positions to vary the series of signals produced on presentation of the insert to the detector, thereby providing numerical identification pulses. 4 claims, 4 figures

39547 Thermographic imaging of nuclear fuel rods. Oldberg, S. Jr. (Electric Power Research Inst., Palo Alto, CA); Honey, R.C.; Falconer, D.G.; Zebroski, E.L. *Nucl. Technol.;* **33**: No. 2, 231-234(Apr 1977).

A method has been demonstrated for imaging details of the fuel-cladding gap region in nuclear fuel rods. The method exploits

the geometry-sensitive variation in fuel-cladding gap conductance. After rapid electric resistance heating of the cladding tube by discharge of a capacitor bank, those regions of cladding cool first that have narrow fuel-cladding gaps. The cladding surface temperature is recorded by an infrared camera with a cathode ray tube display. Potential is seen for the measurement technique as a research tool and as a receiving inspection method.

CONTROL SYSTEMS

39548 (PB—260655) **Documentation of utility experience with process computers in power plants. Technical compendium.** Long, A.B. (MARCO Corp., Fort Washington, Pa. (USA)). Nov 1976. 472p. Q 20/MF A01.

This compendium contains a technical description of the process computer systems at 334 fossil and nuclear generation plants having 100 MWe generating capacity or greater. The information was derived from 91 utilities throughout the U.S. and Puerto Rico as part of a detailed study to document the experience which utilities have had with process computer systems (these results are to be presented in a subsequent volume). The technical descriptions are grouped by system supplier and supplier's model number. Cross references are provided.

39549 (WARD-TP—3045-3) **LMFBR shutdown system reliability test program. Progress report for period ending September 1976.** (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Dec 1976. Contract EY-76-C-02-3045-031. 32p. AT.

Technical progress in the LMFBR shutdown system reliability program is reported. The program covers component tests, subsystem tests, and systems tests for CRBRP and LMFBR shutdown systems.

39550 (WCAP—8829) **Seismic operability demonstration testing of the Westinghouse ISD 7300 Series process instrumentation bistables.** Jarecki, S.J.; Coslow, B.J.; Ellis, A.E.; Miller, R.B. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Dec 1976. 49p. Westinghouse Electric Corp., Pittsburgh, PA.

The report documents the results of the multiple frequency, biaxial seismic testing of the Westinghouse Instrument Systems Division's—7300 Series Process Instrumentation Bistables. This test program established and demonstrated the operability of the 7300 Series bistable trip cards by submitting the equipment to SSE (Safe Shutdown Earthquake) seismic tests corresponding to a high seismic area, preceded by multiple OBE (Operating Basis Earthquake) seismic tests. The test results presented in the report show there were no electrical malfunctions or mechanical failures that could lead to an unsafe condition in the plant.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 39451, 40201, 40217, 40245

39551 (PB—256679) **Effect of mechanical cooling devices on ambient salt concentration. Final report, Feb 1975—Sep 1975.** Hunter, H.E. (ADAPT Service Corp., Reading, Mass. (USA)). Apr 1976. Contract EPA-68-03-2176. 142p. (ADAPT—75-8). NTIS $6.00.

The report presents an analysis of the airborne salt concentration data collected during the demonstration of the salt water mechanical cooling devices at the Turkey Point power plant. The data were analyzed using the ADAPT family of empirical analysis programs which are based on the concept that empirical analysis should be preceded by the development of an optimal (in the Karhunen-Loeve sense) representation of the data. The analysis presented in the report shows that the increase in the background salt concentration due to the cooling tower was less than the measurement accuracy of approximately three to five micrograms per cubic meter. (GRA)

SITING

39552 (NUREG—0171) **Early site review report for the Sundesert site, San Diego Gas and Electric Company. Project No. 558.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Nuclear Reactor Regulation). 10 Feb 1977. 68p. Dep. NTIS $4.50.

The purpose of the report is to present the Nuclear Regulatory Commission's evaluation of several of the matters relating to the suitability of the Sundesert site near Blythe, California, on which the San Diego Gas and Electric Company proposes to build the Sundesert Nuclear Plant, Units 1 and 2. The report summarizes the results of the technical evaluation of the suitability of the proposed Sundesert site for a nuclear plant and delineates the scope of the technical matters considered in evaluating the suitability of the site.

39553 (PB—255908) **Model analysis of effects on water levels at Indiana Dunes National Lakeshore caused by construction dewatering. Water-resources investigations (final).** Marie, J.R. (Geological Survey, Indianapolis, Ind. (USA). Water Resources Div.; National Park Service, Washington, D.C. (USA)). Jul 1976. 38p. (USGS/WRD/WRI—76/048; USGS/WRI—76-82). NTIS $4.00.

Prepared in cooperation with National Park Service, Washington, D.C.

The model analysis indicates that the planned dewatering would cause a drawdown of about 4 ft (1.2 m) under the westernmost pond of the Lakeshore and that this drawdown would cause the pond to go almost dry--less than 0.5 ft (0.15 m) of water remaining in about 1 percent of the pond--under average conditions during the 18-month dewatering period. When water levels are below average, as during late July and early August 1974, the pond would go dry in about 5 1/2 months. However, the pond may not have to go completely dry to damage the ecosystem. If the National Park Service's independent study determines the minimum pond level at which ecosystem damage would be minimized, the models developed in this study could be used to predict the hydrologic conditions necessary to maintain that level. (GRA)

RADIOACTIVE EFFLUENTS

REFER ALSO TO CITATION(S) 40689

39554 (GEAP—14144) **Inhalation dose conversion factors for various radionuclides associated with Liquid Metal Fast Breeder Reactors.** Teresi, J.D.; Boudreau, F.C. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Sep 1976. Contract EY-76-C-03-0893-015. 70p. AT.

The report presents: (1) values of the parameters needed in the estimation of internal radiation doses from inhalation of radioactive aerosols resulting from hypothetical liquid metal fast breeder reactor accidents, (2) the values of the time integrated organ deposited radioactivity per unit of radioactivity inhaled (μCi-days/Ci inhaled) based on a metabolic model that incorporates the respiratory tract model adopted by the International Commission on Radiological Protection Task Group on Lung Dynamics, and (3) the values of the dose conversion factors (F-factors) in Rem per curie inhaled for various important LMFBR radionuclides.

39555 (NP-tr—1965) **Complex model for calculating the propagation of radioactive products in a nuclear power station with water-cooled water-moderated reactors.** Hladky, E.; Kubik, I.; Jancik, O.; Teplov, P.V.; Gimel'shtein, B. Translated from *Jad. Energ.;* **21**: 363-370(1975). 17p. U 02/MF A01.

Sections are included which deal with fission product release from the fuel and radioactivity of the coolant due to fission products and corrosion products. Data are presented for WWER type reactor cooling systems. (DG)

39556 (PB—256262) **Radioactive isotopic characterization of the environment near Wiscasset, Maine using pre- and post-operational surveys in the vicinity of the Maine Yankee Nuclear Reactor. Final report, 1972—1974.** Hess, C.T.; Smith, C.W.; Churchill, C.H.; Burke, G.F. (Maine Univ., Orono (USA)). May 1976. Contract EPA-68-01-2654. 65p. NTIS $4.50.

A comparison of identical surveys of the pre- and post-operational environmental radioactivity is made for the vicinity of the Maine Yankee Atomic Power Reactor, Wiscasset, Maine. Radionuclides are measured in laboratory samples of soil, sediment, well water, surface water, estuarine water, air particulate, air moisture, and precipitation. Field measurements of gamma-ray emitting radionuclides and high pressure ion chamber measurements are also presented. The changes in radionuclide concentration and dose are evaluated using the Maine Yankee Environmental Impact Statement. The most significant changes occur for radionuclides in soils and sediments. Details of the distribution of sediment radionuclides near the outflow of the reactor in Bailey Cove are presented with dose estimtes of 10.6 mrem/year at the sites of greatest specific activity. (GRA)

39557 (PB—257952) **Radiological surveillance studies at the Oyster Creek BWR Nuclear Generating Station.** Blanchard, R.L.; Brinck, W.L.; Kolde, H.E.; Krieger, H.L.; Montgomery, D.M. (Environmental Protection Agency, Cincinnati, Ohio (USA)). Jun 1976. 178p. (EPA—520/5-76/003). NTIS $7.50.

Contents include: radionuclides in water on site; Airborne radioactive discharges; radionuclides in liquid wastes; radionuclides in the aquatic environment; and environmental airborne activity.

CHEMICAL AND THERMAL EFFLUENTS

39558 **Prevention of thermal pollution in atomic power station waste water reservoirs.** Marey, A.N. *Gig. Sanit.;* No. 11, 83-86(1975).

The quantity of heat liberated into cooling water in atomic power stations and polluting rivers and lakes leads to several hygien-

ic problems. The methods for maintaining the legislated maximum temperature increase of 3° in natural reservoirs during the summer can be divided into two basic types. The first is accelerated mixing, which is not as a rule used in the USSR and is being reconsidered in the U.S. The second method involves isolated cooling in a closed circulating water system. This is accomplished with evaporative cooling towers or ponds, which can significantly affect the microclimate. The use of the heat from atomic power stations for industrial purposes is being developed in various countries. In the USSR new atomic power stations connected with large agricultural complex whose greenhouses would waste water heated or with pastureless raising of cattle and pigs are being planned. The use of heated water for massive irrigation and exposed ground heating for early vegetables, algae cultivation for animal and fish feed and the use of cooling ponds in fish cultivation, fattening and processing are being studied. These projects are favorable from a hygienic, as well as an economic, point of view, if radioactive contamination of food can be prevented. References 10: 2 Russian, 8 Western.

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 39507, 39571, 39575, 39591

39559 (HEDL-TI—76034-1) **Liquid metal pipe clamp operation and maintenance manual, October 1975.** (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1975. Contract EY-76-C-04-2170. 35p. AT.

Instructions are presented for the installation, operation, and maintenance of standard round L/M pipe clamps.

39560 (HEDL-TI—76034-12) **Boeing test progress report.** Haug, D.L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Sep 1974. Contract EY-76-C-14-2170. 7p. AT.

The results of thermal tests on pipe clamp assembly and insulating bricks are presented.

39561 (HEDL-TI—76034-15) **Boeing test report, 2-5613-7500-172.** Hess, J.N. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1975. Contract EY-76-C-14-2170. 39p. AT.

Results of thermal and seismic testing of a liquid carrying pipe/clamp assembly are presented.

39562 (ORNL/TM—5459) **Design, fabrication, and initial operation of HTGR-ORR capsule OF-2.** Thoms, K.R.; Kania, M.J. (Oak Ridge National Lab., Tenn. (USA)). 24 Feb 1977. Contract W-7405-ENG-26. 51p. P 04/MF A01.

The OF-2 irradiation experiment was designed and built to test candidate High-Temperature Gas-Cooled Reactor (HTGR) fuel and fuel-rod matrix designs. The capsule was designed with two separate specimen cells, allowing for independent temperature control as well as independent fission gas release measurements. The OF-2 capsule is presently operating at the Oak Ridge Research Reactor (ORR). Initial fuel rod linear heat rates are between 16.4 and 23.0 kW/m (5 and 7 kW/ft) and fuel centerline temperatures are approximately 1150 and 1350°C. Plans are to operate the capsule for nine ORR cycles to accumulate a maximum damage fluence of 9 x 10^{21} neutrons/cm^2 (E < 0.18 MeV).

39563 (TREE-NUREG—1011) **Feasibility study of thermocouple correlation type transit time flowmeter in transient steam—water flow.** Lassahn, G.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1977. Contract EY-76-C-07-1570. 71p. P 05/MF A01.

Low-flow, air-water tests; low-flow, hot-water tests; and steam-water blowdown tests were performed to determine the feasibility of using a thermocouple correlation transit time flowmeter for fluid velocity measurements during Loss-of-Fluid Test blowdown experiments. The results indicate that this type of flowmeter works well in the steady flow conditions tested. However, the system does not work in transient flow experiments in which the averaging time is limited to 1 second, because thermocouple signals do not have enough high frequency content to keep the statistical noise of the correlation process down to a reasonable level.

39564 Application of a high level interactive simulation language to the FFTF operator training simulator. Timpany, D.D.; Worth, G.A. (Westinghouse Hanford Co., Richland, WA). pp 70-72 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

As a part of the FFTF project, the FFTF Operator Training Simulator (OTS) is being built for use as a training tool for reactor operators. This facility will consist of a functional mockup of a major portion of the plant control room with an instructor's station equipped to allow the instructor to initialize and control the simulator through a variety of training exercises. The OTS mockup will be computer driven by a system programmed to simulate the actual FFTF plant. This simulation software must provide real-time synchronous operation and must also allow a high degree of interactivity in order for the instructor to control the operating state of the simulator and to introduce simulated malfunctions. The paper defines software requirements for the OTS computer system and describes the means by which SIMEX, a high level simulation language, was adapted for use on OTS.

39565 Determination of the water contamination at the Training Reactor of Budapest Technical University and in its environment. Viragh, E. (Budapesti Muszaki Egyetem (Hungary). Egyetemi Reaktor). *Izotoptechnika;* **19**: No. 1, 8-16(1976). (In Hungarian).

2 figs.; 7 refs.; 3 tabs.

The drainage treating system of the training reactor (maximum power: 10kW) at Technical University of Budapest is reviewed. As a first approach, the radioactivity of the water is measured by a large volume gamma crystal. Sampling is intermittent. The method of processing consists of evaporation or in the case of volatile isotopes the Dannecker-Kiefer-Maushart dressing method. The total activity of the dressed samples is measured by an equipment being made up of an integrated-circuit co-antico counter and a bell-counter system of detectors with lead-shielding. The thickness of the window of the GM-tube is 1.1 mg/cm^2, its diameter is 20 mm. The background intensity, when the reactor is out of work, is 1.1-1.2 imp/min, the time needed to measure the background and the sample is 50-50 minutes. According to the measurements the training reactor does not enhance the level of radioactivity of environment.

39566 Experience in TRR fuel element fabrication. Hsieh, H.C.; Kung, H.T.; Hsu, N.N.; Cheng, J.H. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). *Nucl. Sci. J. (Taiwan);* **13**: No. 2, 59-69(Jun 1976).

Starting from 1971, the Institute of Nuclear Energy Research engaged itself in developing nuclear fuel technology. A fuel element fabrication plant has been in full operation since September 1973. The first fuel element assembly fabricated was loaded into the TRR core on July 14, 1974. Up to the end of April 1975, 80 fuel assemblies from this plant were put into the reactor. Starting from 1975, R and D work was concentrated on oxide fuel and carbide fuel for power reactors. Special features of the fabrication process are described. Strict quality control measures such as Swing test, chemical analysis, X-ray radiography, He-leak test, eddy current test, ultrasonic test, dilatometric measurement and metallographic examination were applied either along the process line or in the laboratories. Uranium alloy with trace additions of Al and Fe was tested and proved to be a better reactor fuel material.

39567 Anomalous reactivity meter. Larson, H.A.; Sackett, J.I. (Argonne National Lab., Idaho Falls, ID). *Nucl. Technol.;* **33**: No. 2, 223-230(Apr 1977).

An Experimental Breeder Reactor II (EBR-II) anomalous reactivity meter was examined to verify its feasibility as a useful device in a fast reactor system. Anomalous reactivity is calculated by comparing "measured" reactivity with that predicted by system parameters; this provides useful diagnostic, alarm, and possible plant protective functions. Examples include application during an arbitrary rise-to-power for EBR-II as well as effectiveness during an EBR-II loss-of-primary-pumping-power event. Single subassembly flow loss events may be questionable for the crude anomalous reactivity meter described here, but flow disturbances of the magnitude required for this event have been observed with a reactivity meter.

PLUTONIUM AND ISOTOPE PRODUCTION REACTORS

REFER ALSO TO CITATION(S) 39846

39568 HTGR nuclear energy utilization in the metals industry. Simnad, M.; McMain, A.T. Jr. (General Atomics Co., San Diego, CA). pp 53-86 of In Energy use and conservation in the metals industry. Chang, Y.A. (ed.). New York; Metallurgical Society of AIME (1975).

From Annual meeting of the Society of Mining Engineers of AIME; New York, New York, USA (16 Feb 1975).

See CONF-750204—P2.

During the past five years, there has been increasing interest in the use of the HTGR for metallurgical process heat applications in Europe, Japan and the USA. This paper summarizes these activities and reviews the potential and timing for development of these applications. The HTGR can be adapted to deliver high-temperature process heat in quantities and temperature ranges (500 to 1100°C) of interest for many applications in the metals industry. This unique ability stems from the use of helium as the primary coolant coupled

with an all-ceramic core. A promising application of the process heat HTGR in the metals industry is for direct reduction of iron ore. In this application, the HTGR provides process heat for steam reforming light hydrocarbon feedstocks to produce reducing gas. This system can also be used for the production of substitute pipeline gas from coal or oil shale. In addition, nuclear power could supply the electricity for electrolytic ore reduction, electric furnaces for melting and heat treating, rolling mills, and other operations requiring large quantities of electrical energy in the metals industry. 48 references.

PROPULSION REACTORS

39569 (AD-A—029165) **Recommendations for qualifications of engineering personnel of nuclear-powered ships. Final report, Jul 1975—Jul 1976.** Hall, P.; Lewis, R.E.; Roth, D.R.; Paramore, B. (General Physics Corp., Columbia, Md. (USA); Operations Research, Inc., Silver Spring, Md. (USA)). Jul 1976. Contract DOT-CG-41903-A. 150p. (ORI-TR—1011). NTIS $6.00.

Prepared in cooperation with General Physics Corp., Columbia, Md.

The report presents summary recommendations, based on task analysis, concerning training and other qualification requirements appropriate for personnel to serve on future new commercial nuclear ships. Training content and type (Classroom, shoreside practical/simulation, onboard) are recommended for 12 personnel functional areas. The study described in this report is seen as an initial step in the process of developing marine nuclear personnel requirements. Pertinent existing standards and legal requirements are taken into account in the recommendations; however, the need for regulatory guidelines specific to the Merchant Marine environment is identified. The task data presented offer a basis for specific training curriculum development once the regulatory guidelines are defined. In addition to the task data and summary recommendations, the report is a compendium of reference materials including description of the design proposals for new nuclear commercial ships; discussion of nuclear hazards; description of existing standards and legal requirements; and summaries of nuclear personnel requirements for the utilities, the U.S. Navy, and on the prototype NS SAVANNAH. (Author) (GRA)

REACTOR SAFETY

39570 (AI-ERDA—13193) **Subsea nuclear power generating stations for offshore oil production operations. Preliminary safety and licensing information document.** (Rockwell International Corp., Canoga Park, Calif. (USA)). 15 Feb 1977. Contract EY-76-C-03-0701. 48p. P 02/MF A01.

This document presents preliminary safety and licensing information relating to the manufacture, installation, and operation of small subsea nuclear generating stations in remote offshore locations, and the associated onshore base-site activities of reactor refueling and system refurbishment at 4-year intervals. The purpose of the proposed facilities is to provide a subsea power capability for offshore oil production operations in areas where surface conditions, water depths, or other environmental constraints may preclude the use of surface-mounted power sources. This will provide the capability to achieve the maximum recovery of petroleum resources from the U.S. frontier areas. Summary descriptions of a typical subsea nuclear generating station and a typical base site-facility are presented. General safety and licensing considerations are discussed, and a representative schedule of licensing activities is outlined.

39571 (ANL-RDP—56) **Reactor development program progress report, December 1976.** Sachs, R.G.; Kyger, J.A. (Argonne National Lab., Ill. (USA)). 16 Feb 1977. Contract W-31-109-ENG-38. vp. AT.

This progress report summarizes the Argonne National Laboratory work performed for the Reactor Development Program during December 1976 in the following research and development areas: Experimental Breeder Reactor No. II (EBR-II), LMFBR Design Support, Instrumentation and Control, Reactor Physics, Reactor Safety, and Other Fast Breeder Reactors.

39572 (BMI-NUREG—1966) **Critical experiments, measurements, and analyses to establish a crack arrest methodology for nuclear pressure vessel steels. Task 62. Eighth quarterly progress report, July—September 1976.** Hahn, G.T.; Gehlen, P.C.; Hoagland, R.G.; Kanninen, M.F.; Marschall, C.W.; Popelar, C.; Rosenfield, A.R.; Simon, R. (Battelle Columbus Labs., Ohio (USA)). Feb 1977. 107p. Dep. NTIS $5.50.

Progress is reported in studies aimed at developing a testing practice for measuring K/sub Im/, the crack arrest material property of both unirradiated and irradiated steel samples. The merits of the crack-line and wedge loaded single-edge-notched (SEN) specimen as a crack arrest test piece have been investigated. Two-dimensional, dynamic finite difference computations of run-arrest events were carried out on ordinary-and duplex-SEN configurations. In addition to the theoretical calculations, 8 crack arrest experiments on shallow grooved SEN test specimens of A533B steel are described. The feasibility of using electron beam welded "compound" specimens to reduce irradiated material requirements for fracture toughness and crack arrest tests is evaluated.

39573 (BNL-NUREG—50599) **HTGR Safety Evaluation Division. Quarterly report, April—June 1976.** Schweitzer, D.G. (Brookhaven National Lab., Upton, N.Y. (USA)). Nov 1976. Contract EY-76-C-02-0016. 176p. P 09/MF A01.

Progress is reported in the areas of fission product release and transport, primary coolant impurities, rapid graphite oxidation, structural evaluation, materials, accident delineation, and phenomena modeling and systems analysis.

39574 (GEAP—14034-9) **Radiological assessment models. Ninth quarterly report, September—November 1976.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Dec 1976. Contract EY-76-C-03-0893-015. 49p. AT.

The objectives of the program are to develop models based upon analysis and experiment to determine: (1) the amount and the characteristics of radiological materials discharged energetically from the core, transported to the cover-gas space, and available for leakage from the reactor vessel, and (2) the long-term radiological source resulting from a core melt-through as a result of hypothetical core disruptive accidents in liquid metal fast breeder reactors. During this reporting period, the effect of radiative heat transfer on HCDA bubble behavior was investigated. The results indicate the bubble collapse time varies nearly inversely with the sodium absorptivity and that radiation significantly affects bubble behavior. A new model was outlined to determine the attenuation of radionuclides in translating fuel, sodium, or iodine bubbles. A method for evaluating fission product release from sodium was reviewed and applied to a high-temperature sodium pool.

39575 (HEDL-TME—76-55) **Fast reactor safety technical progress report, January—March 1976.** Simpson, D.E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Feb 1977. Contract EY-76-C-14-2170. 151p. AT.

The report describes technical progress on fast reactor safety programs. The programs include reactor safety activities supportive of the Fast Flux Test Facility and associated with development of base LMFBR safety technology. The summaries and technical detail are presented.

39576 (NTISUB/B—108) **Water reactor safety research. Buff book - Volume I. Data as of October 30, 1976. Status summary report.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Nuclear Regulatory Research). 17 Nov 1976. 215p. (NUREG—0135-1). Paper copy also available on subscription, North American Continent price $60.00/year; all others write for quote.

Contents include: project index; LORDS system structure; program phasing chart; master phasing plan; systems engineering; fuel behavior; analysis development; and metallurgy and materials.

39577 (ORNL/NUREG/TM—104) **Calculation of the fragmentation of UO_2 by capacitor discharge: nonequilibrium model.** Alsmiller, R.G. Jr.; Perez, R.B.; Barish, J. (Oak Ridge National Lab., Tenn. (USA)). 3 Mar 1977. Contract W-7405-ENG-26;NRC-INA-40-551-75. 34p. P 03/MF A01.

A model based on phase-space considerations is developed to describe the fragmentation of UO_2 by capacitor discharge—ie., to predict such quantities as the amount of gas and liquid produced, the number of liquid fragments, the number distribution of the molecules in the liquid fragments, the kinetic-energy distribution of the gas and liquid fragments, etc. The model presented cannot give a unique numerical prediction of all of these quantities based only on the initial-state specification, but it does enable all of these quantities to be expressed in terms of the average internal energy of a gas molecule in the final state, the average binding energy of a UO_2 molecule in a liquid fragment in the final state, and the average number of molecules in a liquid fragment in the final state.

39578 (PB—259332) **FLUSH - a computer program for approximate 3-D analysis of soil-structure interaction problems.** Lysmer, J.; Udaka, T.; Tsai, C.; Seed, H.B. (California Univ., Richmond (USA). Earthquake Engineering Research Center). Nov 1975. 150p. (EERC—75-30). Q 04/MF A01.

The general principles of seismic soil-structure interaction by finite element methods are discussed, and the theory and manual for a specific computer code, FLUSH, are presented. This code is a further development of the complex response finite element computer program LUSH (Lysmer et al, 1974). The new program is considerably faster than LUSH, thus the name FLUSH = Fast LUSH, and it includes a large number of new features such as transmitting boundaries, beam elements, an approximate 3-D ability, deconvolution within the program, out-of-core equation solver, new

input/output features, etc., all of which make the program more efficient and versatile. This study includes analyses of soil-structure interaction effects during earthquakes for nuclear power plant structures. (GRA)

39579 (PB—260583) **PWR sensitivity to alterations in the interfacing-systems LOCA. Phase report.** Lellouche, G.S. (Science Applications, Inc., Palo Alto, Calif. (USA)). Sep 1976. 60p. Q 04/MF A01.

One of the important conclusions of the Reactor Safety Study (RSS) was the identification of the interfacing problem between the high pressure primary system and the low pressure injection system (LPIS). Because equivalent interfaces exist in all PWRs (although not necessarily with the LPIS) the NRC has suggested three possible 'fixes' for future designs, the implication being that each such fix is equally acceptable. The present analysis of the basic problem shows up certain minor limitations in the RSS methodology, demonstrates that the three NRC fixes are not equally acceptable from a risk viewpoint, and that one of the fixes could be implemented in such a way as to yield a worse risk condition than the original design. As a demonstration of the power inherent in probabilistic methods, an alternate 'fix' and associated test scheme is suggested which reduces the risk to an insignificant level. (GRA)

39580 (PB—261470) **A prediction of the semiscale blowdown heat transfer test S-02-8 (NRC Standard Problem Five). Key phase report.** Fujita, N.; Irani, A.A.; Mechan, D.C.; Sawtelle, G.R.; Moore, K.V. (Energy, Inc., Idaho Falls, Idaho (USA)). Oct 1976. 115p. Q 06/MF A01.

The RELAP4 prediction and comparison with experimental data of Standard Problem 5 are presented. The prediction was submitted to NRC prior to the release of Test S-02-8 Data. The comparisons show good overall agreement between test data and analytical results.

39581 (PB—261471) **Failure analysis and failure prevention in electric power systems. Final report.** Rau, C.A. Jr.; Besuner, P.M.; Egan, G.R.; Johnson, D.P.; Tetelman, A.S. (Failure Analysis Associates, Palo Alto, Calif. (USA)). Nov 1976. 256p. Q 12/MF A01.

New methods have been developed and applied to better quantify and increase the reliability, safety, and availability of electric power plants. Present and potential problem areas have been identified both by development of an improved computerized data base of malfunctions in nuclear power plants and by detailed metallurgical and mechanical failure analyses of selected problems. The currently specified flaw evaluation procedures of the ASME Boiler and Pressure Vessel Code have been computerized. Results obtained from these procedures for evaluation of specific in-service inspection indications have been compared with results obtained utilizing improved analytical methods. Mathematical methods have also been developed to describe and analyze the statistical variations in materials properties and in component loading, and uncertainties in the flaw size that might be passed by quality assurance systems. These new methods have been combined to develop accurate failure rate predictions based upon probabilistic fracture mechanics. (GRA)

39582 (TREE-NUREG—1029) **Postirradiation examination results for the Power-Cooling-Mismatch Test-2A.** Seiffert, S.L.; Smolik, G.R. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1977. Contract EY-76-C-07-1570. 119p. P 06/MF A01.

The results of the postirradiation examination of a PWR-type, zircaloy-clad, UO_2-fueled fuel rod tested in DNB conditions in an in-pile experimental investigation of power-cooling-mismatch conditions are presented. Visual and metallographic examination of the fuel rod revealed the nature of the cladding collapse which occurred in the zone affected by film boiling and determined that only a small amount of fuel restructuring occurred. A brittle UO_2-Zr reaction layer developed at the fuel-cladding interface when the fuel was in contact with the cladding. Conclusions concerning cladding embrittlement by oxidation are made. A comparison of the cladding surface temperatures estimated metallurgically with calculated cladding surface temperatures from the Fuel Rod Analysis Program-Transient (FRAP-T) computer code is included.

39583 (TREE-NUREG—1040) **FRAP-T2: a computer code for the transient analysis of oxide fuel rods.** Dearien, J.A.; Siefken, L.J.; Bohn, M.P.; Coleman, D.R.; Laats, E.T. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1977. Contract EY-76-C-07-1570. 340p. P 16/MF A01.

Fuel Rod Analysis Program-Transient (FRAP-T) is a FORTRAN IV computer code which can be used to solve the transient response of a light water reactor fuel rod during accidents, such as a loss-of-coolant accident or a power-cooling-mismatch. The coupled effects of mechanical, thermal, internal gas, and material property response on the behavior of the fuel rod are considered. The cladding deformation model includes elastic-plastic deformation. The transient flow of gas between the plenum and gas gap is modeled. FRAP-T is coupled to a material property subcode, MATPRO, which is used to provide gas, fuel and cladding properties to the FRAP-T computational subcodes. No material properties need to be supplied by the code user. The needed water properties are obtained from the 1967 ASME steam tables, which are linked to the code. Critical heat flux and heat transfer correlations for a wide range of coolant conditions are contained in modular subroutines. FRAP-T is a modular code with each major computational model isolated within the code and coupled to the main code by subroutine calls and data transfer through argument lists. The argument lists are completely defined by comment statements at the beginning of each subroutine. The code is presently programmed and running on the IBM 360/75 and CDC 7600 computers.

39584 (TREE-NUREG—1041) **FRAP-T1: a computer code for the transient analysis of oxide fuel rods.** Dearien, J.A.; Miller, R.L.; Hobbins, R.R.; Siefken, L.J.; Baston, V.F.; Coleman, D.R. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1977. Contract EY-76-C-07-1570. 326p. P 15/MF A01.

FRAP-T is a FORTRAN IV computer code which can be used to solve for the transient response of a light water reactor (LWR) fuel rod during accident transients such as loss-of-coolant accident (LOCA) or a power-cooling-mismatch (PCM). The coupled effects of mechanical, thermal, internal gas, and material property response on the behavior of the fuel rod are considered. FRAP-T is a modular code with each major computational model isolated within the code and coupled to the main code by subroutine calls and data transfer through argument lists. FRAP-T is coupled to a materials properties subcode (MATPRO) which is used to provide gas, fuel, and cladding properties to the FRAP-T computational subcodes. No material properties need be supplied by the code user. The needed water properties are stored in tables built into the code. Critical heat flux (CHF) and heat transfer correlations for a wide range of coolant conditions are contained in modular subroutines. FRAP-T has been evaluated by making extensive comparisons between predictions of the code and experimental data. Comparison of predicted and experimental results are presented for a range of FRAP-T calculated parameters. The code is presently programmed and running on an IBM-360/75 and a CDC 7600 computer.

39585 (TREE-NUREG—1052) **Experiment data report for Semiscale Mod-1 Test S-05-3 (alternate ECC injection test).** Feldman, E.M.; Patton, M.L. Jr.; Sackett, K.E. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1977. Contract EY-76-C-07-1570. 226p. P 11/MF A01.

Recorded test data are presented for Test S-05-3 of the Semiscale Mod-1 alternate ECC injection test series. These tests are among several Semiscale Mod-1 experiments conducted to investigate the thermal and hydraulic phenomena accompanying a hypothesized loss-of-coolant accident in a pressurized water reactor (PWR) system. Test S-05-3 was conducted from initial conditions of 2263 psia and 545°F to investigate the response of the Semiscale Mod-1 system to a depressurization and reflood transient following a simulated double-ended offset shear of the cold leg broken loop piping. During the test, cooling water was injected into the cold leg sides of the intact and broken loops and into the vessel upper plenum to simulate emergency core coolant injection in a PWR. For Test S-05-3, specifically the effects of upper plenum coolant injection on core thermal and system response were being investigated.

39586 (TREE-NUREG—1053) **Experiment data report for Semiscale Mod-1 Test S-05-4 (alternate ECC injection test).** Collins, B.L.; Feldman, E.M. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1977. Contract EY-76-C-07-1570. 226p. P 11/MF A01.

Recorded test data are presented for Test S-05-4 of the Semiscale Mod-1 alternate emergency core coolant injection test series. These tests are among several Semiscale Mod-1 experiments conducted to investigate the thermal and hydraulic phenomena accompanying a hypothesized loss-of-coolant accident in a pressurized water reactor (PWR) system. Test S-05-4 was conducted from initial conditions of 2266 psia and 543°F to investigate the response of the Semiscale Mod-1 system to a depressurization and reflood transient following a simulated double-ended offset shear of the cold leg broken loop piping. During the test, cooling water was injected into the cold leg of each loop and into the vessel upper plenum to simulate emergency core coolant injection in a PWR. The upper plenum coolant injection was scaled according to the heat stored in the metal mass of the upper plenum.

39587 (TREE-NUREG—1054) **Experiment data report for Semiscale Mod-1 Test S-05-5 (alternate ECC injection test).** Collins, B.L.; Patton, M.L. Jr.; Sackett, K.E. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1977. Contract EY-76-C-07-1570. 237p. P 11/MF A01.

Recorded test data are presented for Test S-05-5 of the Semiscale Mod-1 alternate ECC injection test series. These tests are among several Semiscale Mod-1 experiments conducted to investigate the thermal and hydraulic phenomena accompanying a hypothesized loss-of-coolant accident in a pressurized water reactor (PWR) system. Test S-05-5 was conducted from initial conditions of 2263 psia and 537°F to investigate the response of the Semiscale Mod-1 system to a depressurization and reflood transient following a simu-

lated double-ended offset shear of the cold leg broken loop piping. During the test, cooling water was injected into the cold leg of the intact and broken loops to simulate emergency core coolant injection in a PWR. The upper plenum was vented through a reflood bypass line interconnecting the hot and cold legs of the broken loop.

39588 (TREE-NUREG—1069) **Power-Cooling-Mismatch Test Series. Test PCM-2: postirradiation examination.** Seiffert, S.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1977. Contract EY-76-C-07-1570. 188p. P 09/MF A01.

The report describes the results of the postirradiation examination of four 0.91-m long pressurized water reactor (PWR) type, UO_2-fueled zircaloy-clad fuel rods tested in an in-pile experimental investigation of pre- and post-departure from nucleate boiling (DNB) behavior of previously unirradiated fuel rods. None of the four fuel rods tested failed during testing or during reactor shut down. Visual and metallographic examination of the individual fuel rods indicated that the length of the high temperature zone of film boiling varied from rod to rod. Two of the four fuel rods showed evidence of damage by film boiling, characterized by oxide spalling and cladding collapse. Metallographic examination of these fuel rods showed internal cladding oxidation resulting from fuel-cladding reaction. Cladding embrittlement by oxidation is evaluated. A comparison of the cladding surface temperatures estimated metallographically for the separate fuel rods with cladding surface temperatures measured during testing and calculated from the Fuel Rod Analysis Program-Transient (FRAP-T) computer code is included.

39589 (TREE-NUREG—1073) **Analysis of the thermal-hydraulic behavior resulting in early critical heat flux and evaluation of CHF correlations for the semiscale core.** Snider, D.M. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1977. Contract EY-76-C-07-1570. 62p. P 04/MF A01.

The report presents analysis of the core thermal-hydraulics associated with early critical heat flux (CHF) in the Semiscale core during the loss-of-coolant accident (LOCA) resulting from a large cold leg pipe rupture. The thermal-hydraulic behavior was solved using COBRA-IV-I with boundary conditions calculated from measured data. Analysis indicated a flow stagnation occurred in the heated core shortly after rupture and lasted until 700 ms after rupture at which time fluid above the stagnation region reversed direction and coolant flowed from the upper plenum down through the core. During the time when a flow stagnation region existed, the core rapidly voided from both ends and this time of rapid emptying corresponded to the time period of measured critical heat fluxes. Analysis indicated the quality was from 30 to 70 percent at the time of CHF suggesting that the mechanism for CHF was dryout of the heater rod surface. The influx of lower quality coolant into the top of the heated core after complete flow reversal reduced the quality in the heated core and produced the observed rewets at about 1.2 s in parts of the core. An evaluation to determine the capability of seven CHF correlations to calculate the time of critical heat flux in Semiscale indicated that those correlations which depended strongly on quality did well in calculating the time of CHF. Those correlations which had the core entrance enthalpy and a length term as independent variables did not adequately calculate the time of CHF.

39590 (TREE-NUREG—1076) **Analysis of Semiscale Mod-1 integral test with asymmetrical break (Test S-29-1).** Langerman, M.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1977. Contract EY-76-C-07-1570. 44p. P 03/MF A01.

Selected experimental data obtained from Semiscale Mod-1 cold leg break Test S-29-1 and results obtained from analytical codes are analyzed. This test was the first integral blowdown reflood test conducted with the Mod-1 system and was a special test designed specifically to evaluate the sensitivity of the early Mod-1 core thermal response (0 to 5 sec after rupture) to the magnitude and direction of the core flow. To achieve this specific objective in Test S-29-1, the vessel side break area was reduced to approximately one-half the scaled break area associated with a 200 percent cold leg break test. The reduction in break area significantly reduced the core flow reversal that took place immediately after rupture and resulted in periods of positive core flow in the early portion of the test. The results obtained from this test are compared with results obtained from a 200 percent cold leg break test and the effect of core flow on early core thermal response is evaluated. Since Test S-29-1 was the first integral blowdown reflood test conducted with the Mod-1 system, data are also presented through the reflood stage of the test and the results are analyzed. The test data and the core thermal response calculated with the RELAP4 code are also compared.

39591 (TREE-NUREG—1086) **Experiment prediction for Loft Nonnuclear Experiment L1-4.** White, J.R.; Berta, V.T.; Holmstrom, H.L.O. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1977. Contract EY-76-C-07-1570. 251p. P 12/MF A01.

A computer analysis, using the WHAM and RELAP4 computer codes, was performed to predict the LOFT system thermal-hydraulic response for Experiment L1-4 of the nonnuclear (isothermal) test series. Experiment L1-4 will simulate a 200 percent double-ended offset shear in the cold leg of a four-loop large pressurized water reactor. A core simulator will be used to provide a reactor vessel pressure drop representative of the LOFT nuclear core. Experiment L1-4 will be initiated with a nominal isothermal primary coolant temperature of 282.2°C, a pressurizer pressure of 15.51 MPa, and a primary coolant flow of 270.9 kg/s. In general, the predictions of saturated blowdown for Experiment L1-4 are consistent with the expected system behavior, and predicted trends agree with results from Semiscale Test S-01-4A, which simulated the L1-4 experiment conditions.

39592 (TRG-Report—2803(D)) **CLAYMORE: a two phase local blockage code with subchannel geometry.** Gregory, C.V.; Lord, D.J. (UKAEA Reactor Group, Dounreay. Dounreay Experimental Reactor Establishment). Nov 1976. 20p. U 02/MF A01.

This paper describes a study to demonstrate the feasibility of the approach embodied in the code CLAYMORE to represent recirculating single and two phase flow in a multipin cluster. Results are presented for calculations with the code including both single channel and multipin geometries with local blockages.

39593 (UCID—17416) **Summary of calculations of dynamic response characteristics and design stress of the 1/5 scale PSE torus.** Arthur, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Feb 1977. Contract W-7405-ENG-48. 36p. P 03/MF A01.

The Lawrence Livermore Laboratory is currently involved in a 1/5 scale testing program on the Mark I BWR pressure suppression system. A key element of the test setup is a pressure vessel that is a 90° sector of a torus. Proper performance of the 90° torus depends on its structural integrity and structural dynamic characteristics. It must sustain the internal pressurization of the planned tests, and its dynamic response to the transient test loads should be minimal. If the structural vibrations are too great, interpretation of important load cell and pressure transducer data will be difficult. The purpose of the report is to bring together under one cover calculations pertaining to the structural dynamic characteristics and structural integrity of 90° torus. The report is divided into the following sections: (1) system description in which the torus and associated hardware are briefly described; (2) structural dynamics in which calculations of natural frequency and dynamic response are presented; and (3) structural integrity in which stress calculations for design purposes are presented; and an appendix which contains an LLL internal report comparing the expected load cell response for a three and four-point supported torus.

39594 (WCAP—8904) **Westinghouse emergency core cooling system evaluation model for analyzing (N-1) loop operation of plants with loop isolation valves.** Kemper, R.M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Dec 1976. 40p. Westinghouse Electric Corp., Pittsburgh, PA.

The report describes an analytical model to be used for performing Appendix K ECCS analyses for a loss-of-coolant accident, which occurs during operation in the (N-1) configuration in a plant equipped with loop isolation valves. The analytical results for ECCS analyses using this model are presented for a Westinghouse 4 loop (15 x 15) plant and for a Westinghouse 3 loop (17 x 17) plant. Sensitivity studies and a discussion of the effect of modeling assumptions are also documented.

39595 (JPNRSR—36) **Description of the ROSA-II test facility.** Shiba, M.; Adachi, H.; Matsumoto, I.; Suzuki, N.; Murata, H.; Chiba, T.; Ito, H.; Osaki, H.; Yamamoto, N. (Japan Atomic Energy Research Inst., Tokyo). 5 Nov 1975. Translation of JAERI-M—6247. 122p. U 06/MF A01.

Work performed under United States Nuclear Regulatory Commission—Light Water Reactor Safety Technical Exchange Program.

The report gives a detailed description of the ROSA-II (Rig of Safety Assessment-II Test Facility) used for the ROSA-II Program which is a simulated Test Program of a loss-of-coolant accident (LOCA) in a pressurized water reactor (PWR) in JAERI. Emphasis of the description is placed on providing information on the Facility to be needed for analysis of the ROSA-II data. Instrumentation is also described in detail.

39596 (EURFNR—1325) **Investigation of the behavior of directly electrically heated UO_2 fuel rods with simulated reactor power transients.** Alexas, A.; Lindner, W. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik). Dec 1975. Translation of KFK—2152. 137p. P 07/MF A01.

Work performed under United States—Euratom Fast Reactor Exchange Program.

The investigation of the LMFBR accidents with very small probability of occurrence requires the analysis of the behaviour of individual pins and pin bundles under postulated accident conditions. One of the possible methods of simulating the behaviour of nuclear fuel pins is out-of-pile experiments where the UO_2 pins are heated electrically in a direct manner. The content of this paper describes a

theoretical treatment for an analysis of this kind, the technical procedures and first experimental results. Starting with the theoretically achievable heating of UO_2 pins, the necessary constraints and technical requirements for a direct electrical heating are specified.

39597 Role of computers in reactor risk analysis. Leverenz, F.L. Jr.; Rumble, E.T.; Garcia, A.A.; Kelly, J.E.; Erdmann, R.C. (Science Applications, Inc., Palo Alto, CA). pp 173-176 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

Recognizing the basic usefulness of risk analysis methodologies, the Electric Power Research Institute (EPRI) has sponsored the pursuit of methodology improvement. Under this sponsorship, Science Applications, Inc., (SAI) has been concentrating on the methodologies and computer codes relating to probabilistic safety analysis using as a baseline the Reactor Safety Study. The various tasks of Reactor Risk Analysis and the codes utilized, and, specifically, the methodology of probabilistic system analysis are described.

39598 (EURFNR—1345) **Mathematical analysis of the hypothetical ejection of a shutdown rod in a helium-cooled, fast-breeder reactor generating 1000 MW.** Jacobs, G.; Schatz, M. (Kernforschungszentrum Karlsruhe (Germany, F.R.)). Mar 1976. Translation of KFK—2264. 48p. Dep. NTIS $4.00.

Work performed under United States—Euratom Fast Reactor Exchange Program.

A hypothetical accident in a 1000-MWe helium-cooled fast breeder reactor is investigated—the ejection of a shutdown rod left in the core by mistake when the reactor is run up to full power. In addition to the presentation and discussion of the mathematical results, the report contains a description of the models employed and, in the appendix, a complete schedule of the data used.

39599 (EURFNR—1344) **Analysis of the thermal interaction between fuel and sodium with the aid of a precise thermodynamic and hydrodynamic model.** Jacobs, H. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Apr 1976. Translation of KFK—2260. 186p. P 09/MF A01.

Work performed under United States—Euratom Fast Reactor Exchange Program.

The new MURTI fuel-coolant interaction model and a variety of studies performed with the corresponding code are presented. MURTI substantially differs from other FCI models in that the coolant is treated as a heat-conducting compressible medium. Thus, spatial variations of its variables of state are fully taken into account and the model applies equally well to all interacting media irrespective of their thermal conductivities, to all degrees of hot material fragmentation, and to all mixing ratios. Similar to other FCI models, the zone of interaction is allowed to expand in the axial direction only, but in MURTI it may be subdivided axially. Therefore, it is possible to describe axial pressure and velocity profiles, incoherent interactions, and inhomogeneous zones of interaction. Using the MURTI code, several problems of a basic nature are studied which arise in the theoretical description of fuel-sodium interactions.

39600 (INEL-TR—11) **Interim report on the NSRR experimental results (1). Orientational test series: (Tests 111-1—111-6).** Hoshi, T.; Inabe, T.; Shiozawa, S.; Kobayashi, S.; Hashimoto, O.; Kim, B.S. May 1976. Translation of JAERI Memo—6567. 48p. P 03/MF A01.

The in-pile experiments on the nuclear reactor fuel behavior under reactivity initiated accident conditions were started in the NSRR (Nuclear Safety Research Reactor), JAERI, in October 1975. This report describes the results of the initial scoping test series (Test No. 111-1 to 111-6) performed during October and November of 1975. In this test series, 12.23 mm O.D. Zircaloy-2 clad fuel rods containing 2.6 percent enriched UO_2 pellets (JPDR-II fuel rods) and 10.72 mm O.D. Zircaloy-4 clad fuel rods containing 10 percent enriched UO_2 pellets (standard test fuel rods) were used. The test fuel rod was fitted into a stainless steel capsule filled with water, together with necessary test instrumentation, and subjected to a pulse power of the NSRR. The energy insertion into the test fuel given by a single pulse was varied from approximately 40 cal/g of UO_2 to 290 cal/g of UO_2. As the result of post-irradiation measurement, the following features were observed. In Test 111-3 (159 cal/g of UO_2 case), cladding surface was oxidized and wholly discolored over the UO_2 stack region and slightly bent, while in the tests with energy insertion of up to 100 cal/g of UO_2, no visible change on cladding surface was observed. In Test 111-4 (214 cal/g of UO_2 case), oxidation of cladding was such that very thin layer of a part of cladding seemed to have dropped away. In Test 111-5 (237 cal/g of UO_2 case), two penetrating circumferential cracks took place in cladding, and in Test 111-6 (292 cal/g of UO_2 case), almost all of UO_2 pellets melted and the test fuel rod was broken into five large pieces.

39601 (PB—255901-T/SL) **Acoustic emission method for tracing crack propagation in pressure vessels.** (Japan Atomic Energy Research Inst., Tokyo; Central Research Inst. of Electric Power Industry, Tokyo (Japan); Tokyo Univ. (Japan). Inst. of Industrial Science). Aug 1976. Translation of Japan Atomic Energy Research Inst. (Japan) Memo, n5753, Jun 1974. (JAERI-M—0-5753). 188p. NTIS $7.50.

A hemispherical model and the Number 4 pressure vessel model were used as samples to determine the usefulness of acoustic emission (AE) method in tracing internal pressure fatigue crack propagation in light water reactor pressure vessels. In the hemispherical model, artificial notches were fabricated at the top. In the Number 4 pressure vessel model, two types of artificial notches were fabricated at the points of origin of the maximum stress (corners of the inner surface of the nozzles) in four nozzles with different shapes which were mounted on the model itself. The AE method was used to investigate the process of crack initiation and propagation from these artificial notches by means of repeated loading with internal pressure. Useful data concerning the properties of AE and the points of origin of AE (positional tracking) were obtained when cracks were initiated and propagated in structures having complex shapes. Smek gages and crack gages mounted on the nozzle corners to investigate the track initiation and propagation behavior were used simultaneously with AE methods. It was established that there is a close connection between them. (GRA)

39602 (PB—257532) **Feasibility study of on-line safety evaluation and monitoring of malfunctions of the nuclear reactor system by dynamic data system. Final report.** Wu, S.M. (Wisconsin Univ., Madison (USA). Dept. of Mechanical Engineering and Statistics). Aug 1976. 156p. NTIS $6.75.

This report describes an advanced time series analysis methodology and illustrates its use in application to reactor core barrel dynamics problems. Auto-regressive moving average (ARMA) time series modeling is used. To demonstrate the viability of this data-dependent approach, neutron noise data from two nuclear units were analyzed. The report claims these analyses duplicated classical statistical results, but without complications of variance or bias. The superiorty of the time series method in procuring parameter estimates in a data-efficient manner is also discussed. (GRA)

39603 (PB—257568) **Weld repair of Heavy Section Steel Technology program vessel V-7. Final report.** Goins, W.D.; Butler, D.L. (Combustion Engineering, Inc., Chattanooga, Tenn. (USA). Welding Engineering Dept.). Aug 1976. 70p. NTIS $4.50.

The in situ repair of a flaw in a large nuclear pressure vessel is likely to be a complex undertaking. Normally, a thermal stress relief is required to reduce peak welding stresses; however, accomplishing this task under field conditions can result in difficulties related to warpage of the vessel. Consequently, Section XI of the ASME Boiler and Pressure Vessel Code has provided guidelines for making major repairs without a subsequent thermal stress relief. The Heavy Section Steel Technology (HSST) Program has been pressure-testing intermediate sized vessels roughly scaled to nuclear reactor pressure vessels. One such vessel - ITV-7, intentionally flawed in the axial direction, was hydraulically pressurized to failure - leakage occurred when the vessel was pressurized to 2 1/2 times the design pressure. Arrangements were made with the HSST Program Office to use this vessel for the purpose of repairing the thru wall flaw according to Section XI procedures. The repair was performed to demonstrate the utility of such a weld repair. This report documents details of the procedures used with that repair. (GRA)

39604 (SAND—77-6005) **Experimental study of sodium fires on concrete based on the sodium-concrete reaction and its consequences: study of the behavior of various concretes under metallic sheaths.** Berlin; Colome, J.; Malet, J.C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Surete Nucleaire). Apr 1977. Translation by P. Newman of SESR-R29. 23p. P 02/MF A01.

The problem created by the violent reaction between hot sodium and concrete has only recently been recognized. Its importance was evidenced during experiments in which the sodium-barium oxide concrete reactions led to violent explosions. SESR approached this question during its experimental programs Cassandre and Lucifer. The Cassandre 01 experiment demonstrated the sodium-ordinary concrete reaction, where sodium was burned directly in a concrete vat. The consequences of this fire, pulverization of sodium particles, explosions and deterioration of the concrete led to consideration of protecting the concrete. Among possible shieldings sheath metal appeared to be the safest solution. The Cassandre 08, Lucifer 01 and Lucifer 04 experiments were used to study the behavior of various qualities of concrete protected from fire by a metal wall. The results show that a metal cladding efficiently protects concrete from sodium leaks.

39605 Experimental emergency core cooling results from loft non-nuclear tests. Leach, L.P. (Idaho National Engineering Lab., Idaho Falls); Ybarrondo, L.J.; McPherson, G.D. *Nucl. Technol.;* **33**: No. 2, 126-149(Apr 1977).

The first two loss-of-coolant experiments have been performed in the Loss-of-Fluid Test (LOFT) Facility. The experimental

results are compared to analytical model results from the RELAP4 computer code. LOFT is a pressurized water reactor specially designed and instrumented to perform experiments representative of a loss-of-coolant accident (LOCA) in a power reactor. For these first two experiments, the nuclear core was not installed in LOFT. The first experiment was initiated from a pressure of 9.3 MPa with water at 282°C, and the break represented a half-size double-ended offset shear in the hot leg of a power reactor. The second experiment was initiated from a pressure of 15.3 MPa, a temperature of 282°C, and simulated a complete double-ended offset shear in the cold leg of a power reactor. In the first experiment, emergency core cooling was injected by low-pressure, high-pressure, and accumulator emergency core cooling systems at times representative of what would occur in a LOCA in a power reactor.

ENERGY STORAGE

COMPRESSED GAS

39606 (CONS/NSF/42—1) **Preliminary feasibility evaluation of compressed air storage power systems. Volume I. Final report, June 1975—December 1976.** (United Technologies Research Center, East Hartford, Conn. (USA)). Dec 1976. Contract NSF-R76-952161-5. 318p. P 18/MF A01.

The object of this program was to conduct a preliminary technical, economic, and environmental feasibility evaluation of generating peak power with a compressed air power system incorporating a modified state-of-the-art gas turbine and an hydraulically-compensated, mined, hard-rock cavern. The compressor and turbine sections of the gas turbine would be alternately coupled to a motor/generator for operation during different time periods. During nighttime and weekend off-peak periods, low-cost power would be used to compress air which would be stored in the underground cavern. During subsequent daytime peak-load periods the compressed air would be withdrawn from storage, mixed with fuel, burned and expanded through the turbines to generate peak power. This preliminary evaluation program consisted of a three-phase analytical study effort which provided an in-depth, engineering investigation into the uncertainties associated with the air storage concept. Results are presented covering the siting potential and economics for hard-rock storage caverns, the types of aboveground equipment which could be used with suitable modifications, system performance and economics, and the potential for electric utility application. The technical approach was based on technology currently available, although in some cases not yet reduced to commercial practice. By focussing on state-of-the-art technology, it was possible to identify a low-risk design approach capable of producing about 250 MW which could be considered for near-term commercial application. The design approach has the distinct advantage of providing considerable flexibility with respect to storage conditions without altering the basic configuration or expensive low-pressure components. This practical approach to design was augmented by inclusion of three electric utilities on the project team to infuse utility needs, objectives, background, and experience into the program.

CAPACITOR BANKS

39607 **Determination of overheatings in power capacitors during unsteady conditions of operation.** Chatinyan, Yu.S. (Erevan Polytech Inst, Arm SSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 9, 37-41(Sep 1976). (In Russian).

T.L.

FLYWHEELS

39608 (UCRL—50033-76-4) **Fiber-composite flywheel program. Quarterly progress report, October—December 1976.** Stone, R.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Feb 1977. Contract W-7405-ENG-48. 15p. P 02/MF A01.

Research progress is reported on thin-rim-flywheel testing, composite properties, epoxy resins, composite flywheel design study, and dynamic fatigue. (TFD)

THERMAL

REFER ALSO TO CITATION(S) 39416, 39669, 39800

39609 (ANL-K—76-3364-1) **Consumer thermal energy storage costs for residential hot water, space heating and space cooling systems.** (TRW Systems Group, McLean, Va. (USA)). 30 Nov 1976. Contract W-31-109-ENG-38;SUB-31-109-38-3364. 47p. P 03/MF A01.

The cost of household thermal energy storage (TES) in four utility service areas that are representative for hot water, space heating, and space cooling systems in the United States is presented. There are two major sections of the report: Section 2.0 is a technology characterization of commercially available and developmental/conceptual TES systems; Section 3.0 is an evaluation of the consumer cost of the three TES systems based on typical designs in four utility service areas.

39610 (TID—27552) **Investigation of metal fluoride thermal energy storage materials. Progress report, September 15, 1976—October 14, 1976.** Eichelberger, J.L. (Pennwalt Corp., King of Prussia, Pa. (USA). Technological Center). Oct 1976. Contract EY-76-C-02-2990. 12p. P 02/MF A01.

Most of the effort during the reporting period was spent sorting and evaluating the thermophysical data of the metal fluorides. Cost analyses for production of some of the metal fluorides were completed. Organization of the data concerning cost, reserves, and resources of the constituent metals was continued.

39611 **Thermal accumulators.** O'Callaghan, P.W.; Probert, S.D. (Cranfield Inst. of Tech., Bedford, Eng.). *Appl. Energy;* 3: No. 1, 51-64(Jan 1977).

A preliminary procedure was developed for assessing the prospective performance of idealized sensible- and latent-heat storage systems. Design charts relating storage volume, thermal capacity, boundary insulant thickness and time constant are presented.

39612 **Heat storage tank.** Harrison, H. (to Halm Instrument Co., Inc.). US Patent 4,010,731. 8 Mar 1977. Filed date 23 Oct 1975. 4p.

The heat storage tank is mounted in a pit in the ground. The pit preferably has four sides and a bottom. A lining of insulating material mounted against the sides of said pit. A water impervious liner tank is mounted against the insulation. A top rests on the contents of the tank. At least one insulating barrier extends down from said top to a point adjacent the bottom of said tank, the barrier dividing said tank into portions. Heat storage material substantially fills the tank. The heat storage material has sufficient voids to permit circulation of heat transfer liquid. A hot liquid intake pipe extends adjacent to the bottom of the tank in the center portion. A cool liquid out-take pipe extends adjacent to the bottom of said tank in a side portion. A heat exchanger is located in the upper center portion of the tank.

39613 **Cold storage tank.** Harrison, H. (to Halm Instrument Company, Inc.). US Patent 4,011,736. 15 Mar 1977. Filed date 12 Nov 1975. 4p.

A cold storage tank is mounted in a pit in the ground. An outer plastic sheet barrier lines the pit. A lining of incompressible insulating material lines the interior surface of the outer barrier. An inner plastic sheet barrier lines the interior surfaces of the insulation. A plurality of bags of fresh water are mounted inside of the inner barrier. Brine and gravel fills the inner barrier and the voids between said fresh water bags and covers the fresh water bags. An out-take pipe extends into the brine and is connected to a pump. A shallow tray is mounted above ground and the out-take pipe is connected to spray the brine onto the tray during freezing weather. An intake pipe is connected to drain the tray and return the cooled brine to the interior of the inner barrier. The brine surrounding the water bags is circulated through a heat exchanger for cooling air when required. Therefore the water in the bags will be frozen during freezing weather and cool air may be drawn out during warm weather for house or other cooling purposes.

BATTERIES

REFER ALSO TO CITATION(S) 39782

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 39639, 39646, 39782

39614 (ANL-K—76-3543-1) **Design and cost study of a zinc/nickel oxide battery for electric vehicle propulsion. Final report.** (Yardney Electric Corp., Pawcatuck, Conn. (USA)). Oct 1976. Contract W-31-109-ENG-38;Sub-31-109-38-3543. 118p. P 06/MF A01.

A preliminary design and cost study of a zinc/nickel oxide battery suitable for electric vehicle propulsion was conducted with the objectives of verification of zinc/nickel oxide battery state-of-technology, projection of the state-of-technology battery manufacturing processes, including capital facility requirements, at pilot plant and production plant levels of operation, and recommendation of a preliminary test procedure and standards. A state-of-technology

four-cell zinc/nickel oxide battery module is specified having the following principal characteristics: Capacity (C/2 rate), 310 Ah; Voltage, 6.4 V; Total energy content (C/2 rate), 1.98 kWh; Weight, 26.4 kg; Specific energy (C/2 rate), 75 Wh/kg; Specific power (sustaining; peak), 68 W/kg; 250 W/kg; Cycle life (60 percent depth at C/2 rate), 500. Battery manufacturing processes and costs are defined for initial pilot production of the state-of-technology zinc/nickel oxide battery at 1000 25-kWh batteries per year to final pilot production of the advanced technology unit at 5000 25-kWh batteries per year. Production of the advanced technology battery in a highly automated dedicated facility is then defined for plant capacity developing from 10,000 to 100,000 25-kWh batteries per year. This volume could be reached in 1986; the product would cost $34/kWh. Preliminary test procedures and standards for cells and batteries were defined including evaluation of basic performance, environmental effects and safety, by means of a comprehensive test matrix. 14 figures, 10 tables.

39615 (ANL-K—77-3621-1(Vol.1)) **Cost and design study for electric vehicle lead—acid batteries.** (ESB, Inc., Philadelphia, Pa. (USA)). 1977. Contract W-31-109-ENG-38;31-109-38-3621. 441p. P 19/MF A01.

A design and cost study for electric-vehicle lead—acid batteries is presented; a research and development program leading to demonstration and testing of 20- to 30-kWh batteries is proposed. Both flat pasted and tubular positive electrodes are included. Detailed testing programs are set forth. 110 figures, 8 tables (RWR)

39616 **Battery design.** Wittmann, A. (to Hughes Aircraft Co.). US Patent 4,000,350. 28 Dec 1976. Filed date 17 Mar 1975. 4p.

A battery comprises a battery vessel, battery plates having a central aperture, electrolyte-impregnated separator, a battery plate holder, and a battery plate retainer. The battery plate holder comprises a base retainer and a central tube protruding from the base retainer. The battery plates are placed onto the battery plate holder by inserting the central tube through the apertures in the battery plates. The battery plate retainer holds the plates onto the battery plate holder, and the complete assembly comprising the battery plates, the holder, and cover is mounted with the battery vessel by coupling the base plate of the holder to the interior of the vessel. 5 figures.

39617 **Chrysler long life battery concept.** VanHalteren, C.J. Warrendale, PA; Society of Automotive Engineers (1977). 9p. (CONF-770205—30).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The Chrysler Long Life Battery Concept Paper covers the establishing of the causes for batteries being removed from service, the determination of the cause for removal, and the design changes in the battery and its electrical and thermal environment to create the Long Life Battery Concept. The test shows the importance of controlling the vehicle environment as well as the battery construction in accomplishing the goal. 13 figures, 2 tables.

39618 **New design for the high-performance sodium—sulfur battery.** Hattori, S.; Yamaura, M.; Kimura, S.; Iwabuchi, S. Warrendale, PA; Society of Automotive Engineers (1977). 9p. (CONF-770205—39).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

This paper describes a new design for the sodium—sulfur battery employing a new cell construction including a new method to join the solid electrolyte tube with the sodium reservoir made of metal, and an improved composition of the cell case to solve the problems of premature cell destruction and capacity decrease associated with the conventional design. A higher and more stable performance of the new design than that of the conventional design was shown through various evaluation tests. 11 figures, 7 tables.

39619 **Some UK progress in sodium—sulfur technology.** Lomax, G.R. Warrendale, PA; Society of Automotive Engineers (1977). 8p. (CONF-770205—40).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Some progress made in the UK on sodium—sulfur cells designed for motive power applications is described. This is an area where compatibility with vehicle design imposes design constraints on the cell. The state of the art of the cell components is reviewed. Most of the design problems associated with the sodium electrode have been solved. Electrolyte 33 mm dia and over 500 mm long can now be produced, and the strength and conductivity can be controlled. Factors controlling the rechargeability of the sulfur electrode were studied, and 90 percent capacity retention was achieved for 8000 hours without any deterioration of performance. A 100-Ah cell completed 60 charge—discharge cycles without any significant deterioration of performance. 8 figures, 4 tables.

39620 **Chemoelectric battery.** Lindstrom, O.B. US Patent 4,008,099. 15 Feb 1977. Priority date 14 Mar 1975, Sweden. 18p.

A battery includes a plurality of bipolar electrodes which include a wall, positive electrode material disposed on one side of the wall, and negative electrode material disposed on another side of the wall. Electrolyte chambers separate the electrodes. At the top of each electrolyte chamber a gas lock is provided. The gas locks are interconnected by fluid conduits. The conduits communicate with the gas locks at a level disposed below the top of the electrolyte chamber. Pressure build-ups in one electrolyte chamber can thus be distributed to the gas locks of other electrolyte chambers. Hydrophobic plugs can be disposed within the conduits which permit the passage of gas, but restrict the passage of electrolyte. 10 figures.

39621 **Storage battery with common expansion and filler chamber.** Perkams, W. (to AS-Motor GmbH KG). US Patent 4,008,355. 15 Feb 1977. Priority date 19 Apr 1975, German, Federal Republic of (F.R. Germany). 4p.

To prevent differential electrolyte levels in the various cells of a storage battery having a common expansion and filler chamber, while preventing internal short circuits through the electrolyte, each cell is formed with an overflow tube extending just below the normal electrolyte level of each cell, and an inlet tube flush with the expansion and filler chamber and having general U-shape, extending first downwardly and then upwardly. The U-shaped tube is at least partly filled with electrolyte to form resistance to the flow of gases and electrolyte liquid from a particular cell back into the expansion and filler chamber through the inlet tube, rather than through the overflow tube, which extends above the wall separating the common expansion and filler chamber and the individual cell. A constriction or fluid choke may also be included in the U-shaped tube, which is preferably constructed as a stub pipe extending from the common expansion and filler chamber into a side pocket formed at the side wall of the battery. Each pocket is in open fluid communication with the respective cell just beneath the separating wall. The pockets are molded at the outside walls of the cells of the battery box so that plates or square configurations can be inserted therein. 2 figures.

39622 **Chalcogenide battery.** Whittingham, M.S. (to Exxon Research and Engineering Co.). US Patent 4,009,052. 22 Feb 1977. Filed date 5 Apr 1976. 8p.

A battery is provided in which the anode contains as the anode-active material a metal selected from the group consisting of Group Ia metals, Group Ib metals, Group IIa metals, Group IIb metals, Group IIIa metals, and Group IVa metals (lithium is preferred). The cathode contains as the cathode-active material a chalcogenide of the formula MZ/sub x/, wherein M is an element selected from the group consisting of titanium, zirconium, hafnium, niobium, tantalum, and vanadium (titanium is preferred); Z is an element selected from the group consisting of sulfur, selenium, and tellurium, and x is a numerical value between about 1.8 and about 2.1. The electrolyte is one which does not chemically react with the anode or the cathode and which will permit the migration of ions from the anode-active material to intercalate the cathode-active material. A highly useful battery may be prepared utilizing lithium as the anode-active material, titanium disulfide as the cathode-active material, and lithium perchlorate dissolved in tetrahydrofuran (70 percent) plus dimethoxyethane (30 percent) solvent as the electrolyte. Alternatively, the battery may be constructed in the discharged state of a cathode containing as the cathode-active material an intercalated chalcogenide in which the intercalating species is derived from the same materials previously mentioned as being useful for the anode-active material and the chalcogenide would be the same as that previously described. In this alternate type of battery, the anode may merely be a substrate (e.g., a metal grid) capable of receiving the intercalating species deposited thereon. 1 table.

39623 **Air depolarization cell or battery.** Gerbier, G. (to Saft-Societe des Accumulateurs Fixes et de Traction). US Patent 4,009,320. 22 Feb 1977. Priority date 11 Mar 1975, France. 4p.

The invention concerns an air depolarization cell or battery. The positive electrode is supplied with air through at least one cavity formed by at least two funnels formed directly by molding or otherwise in the mass of the positive electrode separated by a portion of the mass of the positive electrode, each funnel communicating with the outside air at one of their ends and communicating together by a passageway similarly formed directly in the mass of the positive electrode at the level of their other ends. The ratio between the area of the surface of each funnel through which air flows into the electrode and the volume of air therein is different for the two funnels.

39624 **High temperature secondary batteries.** Askew, B.A.; Holland, R. (to National Research Development Corp.). US Patent 4,013,818. 22 Mar 1977. Priority date 28 Sep 1974, United Kingdom of Great Britain and Northern Ireland (UK). 4p.

The invention concerns a high-temperature lithium—sulfur secondary battery. The cells of the battery are arranged in a stack. Each cell consists of a pellet of immobilized electrolyte sandwiched

between a lithium-containing negative electrode pellet and a metal sulfide positive electrode. Intercell metal sheets both maintain electrical contact and inhibit chemical reaction between the electrodes of adjacent cells. The stack of cells is enclosed in a close-fitting tube of chemically inert and electrically insulating material. 2 figures.

39625 Electrolytic cells. Cleaver, B.; Rowlands, G.J. (to National Research Development Corp.). US Patent 4,015,054. 29 Mar 1977. Filed date 18 Aug 1975. 4p.

A lithium/chalcogen thermal cell having a ceramic electrolyte and a lithium ion-containing salt intermediate the anode and the electrolyte is described. The chalcogen is preferably selenium or sulfur and the ceramic electrolyte is preferably βalumina, or β''alumina, or $Li_4—SiO_4$, or Li_4TiO_4. Contact between the anode and the electrolyte is prevented by the intermediate salt and the ceramic electrolyte prevents self-discharge of the cell resulting from dissolution of the electrode materials. 2 figures.

39626 Some aspects of lithium—copper compound cells in LiCl—KCl eutectic. Eichinger, G. (Tech. Univ. of Munich). *J. Power Sources;* **1**: No. 3, 237-247(Apr 1977).

The electrochemical behavior of cupric and cuprous sulfide in LiCl—KCl eutectic and possible side reactions thereof were investigated. These sulfides are valuable electrode materials showing reversible behavior during cycling. Formation of cuprous sulfide occurs if metallic copper and cupric sulfide are present together in the eutectic. Nevertheless, there seems to be a re-formation of the starting material (cupric sulfide or a defined cupric—cuprous sulfide mixture are formed in the original or a very similar composition during re-oxidation). Because of the similar potentials of the sulfides only one voltage plateau is observed during discharge. The formation of highly soluble copper chlorides and sulfur occurs at potentials well above that of the copper sulfide re-formation and, therefore, causes no problems. 8 figures.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 39617, 39628, 39778, 39779, 39780, 39781

39627 New rating standards for automotive batteries. Bennett, R.L. Warrendale, PA; Society of Automotive Engineers (1977). 9p. (CONF-770205—29).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The Battery Subcommittee of the SAE Electrical Equipment Committee developed new standards for rating automotive batteries. The need for the new ratings and their advantages over the former ratings are discussed along with the new "Reserve Capacity," "Cold Cranking, and "Life Test" test procedures. These new standards closely simulate actual operating conditions in today's cars, and their adoption will allow the battery suppliers increased design flexibility. 7 figures, 2 tables.

MATERIALS, COMPONENTS, AND AUXILIARIES

39628 (ANL—76-119) **Instrumentation for automatic cycling of lithium—aluminum/iron sulfide secondary cells.** Olsen, W.F.; Slawecki, M.A. (Argonne National Lab., Ill. (USA)). Dec 1976. Contract W-31-109-ENG-38. 15p. P 02/MF A01.

In the development of lithium—aluminum/iron sulfide secondary cells at Argonne National Laboratory, an instrumentation system was necessary to operate experimental cells automatically over extended periods of time. The system described in this report provides the capability for control of cell cycling and recording of data without the need for constant attendance by research personnel. In these tests electrical performance, power, energy storage capacity cyclelife and cell lifetimes are determined by repetitive charging and discharging of the cells. 5 figures.

39629 (CONS/2114—3) **Study of the auxiliaries for lead—acid battery systems for peaking power. Final report for the period ending October 1976.** (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Dec 1976. Contract EX-76-C-01-2114. 274p. P 12/MF A01.

This volume deals with the elements of the peaking power battery system which are neither the cells nor the power converter hardware per se, but which are nonetheless required to make the system work. These include all hardware and systems required for operational control of the batteries as well as for the safety and protection of the installation and personnel. The first part of the study is concerned with the definition of the requirements for the auxiliaries, creation of a conceptual design which meets the requirements, and the performance of a cost estimate of the design. The second part delineates the effects of changes in auxiliaries design. Areas addressed are hardware sharing with the power converter gear, system reliability, impact of cooling and ventilation systems, effects of system rating on auxiliaries costs, and the effects of advances of technology in monitoring and protection devices with the use of large-capacity cells. It was found that the most economic choice for a 10-MW, 40-MWh peaking power battery system using 5-kWh cells consists of a 1620 Vdc, 10-string design. The projected cost of installation is $3,071,000, of which $1,045,000 is auxiliaries cost. The total cost per kW was found to be a steadily decreasing function of system rating; it was $325/kW at a 10 MW rating. Water cooling of the battery is the most economic choice for virtually every climate. 45 figures, 46 tables. (RWR)

39630 Method of preparing porous, active material for use in electrodes of secondary electrochemical cells. Vissers, D.R.; Nelson, P.A.; Kaun, T.D.; Tomczuk, Z. (to Energy Research and Development Administration). US Patent Application 652,696. 27 Jan 1976. 21p.

Particles of carbonaceous matrices containing embedded electrode active material are prepared for vibratory loading within a porous electrically conductive substrate. In preparing the particles, active materials such as metal chalcogenides, solid alloys of alkali or alkaline earth metals along with other metals and their oxides in powdered or particulate form are blended with a thermosetting resin and particles of a volatile to form a paste mixture. The paste is heated to a temperature at which the volatile transforms into vapor to impart porosity at about the same time as the resin begins to cure into a rigid, solid structure. The solid structure is then comminuted into porous, carbonaceous particles with the embedded active material. 1 figure, 4 tables.

39631 Compartmented electrode structure. Vissers, D.R.; Shimotake, H.; Gay, E.C.; Martino, F.J. (to Energy Research and Development Administration). US Patent Application 657,525. 12 Feb 1976. 13p.

Electrodes for secondary electrochemical cells are provided with compartments for containing particles of the electrode reactant. The compartments are defined by partitions that are generally impenetrable to the particles of reactant and, in some instances, to the liquid electrolyte used in the cell. During cycling of the cell, reactant material initially loaded into a particular compartment is prevented from migrating and concentrating within the lower portion of the electrode or those portions of the electrode that exhibit reduced electrical resistance. 3 figures, 1 table.

39632 Calcium alloy as active material in secondary electrochemical cell. Roche, M.F.; Preto, S.K.; Martin, A.E. (to Energy Research and Development Administration). US Patent 3,980,495. 14 Dec 1976. Filed date 19 Dec 1975. 8p.

PAT-APPL-642,438.

Calcium alloys, such as calcium—aluminum and calcium—silicon, are employed as active material within a rechargeable negative electrode of an electrochemical cell. Such cells can use a molten salt electrolyte including calcium ions and a positive electrode having sulfur, sulfides, or oxides as active material. The calcium alloy is selected to prevent formation of molten calcium alloys resulting from reaction with the selected molten electrolytic salt at the cell operating temperatures. 1 table.

39633 Battery having polyamide hot melt adhesive seal. Feldhake, R.H. (to ESB Inc.). US Patent 3,997,365. 14 Dec 1976. Filed date 10 Dec 1973. 8p.

A battery has a peripheral seal which surrounds the electrodes. The seal comprises a plurality of layers adhered together, one of which layers is metal and another one of which is plastic. The seal is produced between the metal and plastic layers. The seal uses a hot melt adhesive containing substantial amounts of polyamide having a viscosity of from about 1 poise to about 100 poise at 350°F. 8 figures, 1 table.

39634 Electrode for alkaline storage battery and method for manufacture thereof. Takahashi, S.; Miyake, Y. (to Agency of Industrial Science and Tech.). US Patent 4,000,004. 28 Dec 1976. Priority date 23 Oct 1972, Japan. 6p.

An anode for use in the alkaline storage battery, which anode comprises an iron electrode incorporating a permanent magnet, is described. 5 figures.

39635 Storage battery charging system with alternator output fault indicating circuit. Sheldrake, L.J.; Ruff, D.O.; King, C.W. (to General Motors Corp.). US Patent 4,000,453. 28 Dec 1976. Filed date 17 Dec 1975. 12p.

A circuit is disclosed for indicating faults in a storage battery charging system of the type including a voltage regulator-controlled alternator field winding switching transistor and a rectifier circuit having a diode trio which supplies alternator field winding energizing current. A differential amplifier circuit, to which is applied normally equal reference and sensing potentials which become unbalanced with alternator faults, produces a first fault-indicating signal in the event of an alternator malfunction. A transistor having the control electrode connected to the output of the field winding diode trio of the rectifier circuit produces a second fault-indicating

signal in the event of a failure of one of these diodes. These fault-indicating signals trigger a transistor conductive to complete an energizing circuit for a fault-indicating device. Additionally, an oscillator flashes the fault-indicating device "on" and "off" in the event of a voltage regulator failure. 1 figure.

39636 Breaker switch for auto battery. Carter, E.L.; Spector, G. US Patent 4,000,388. 28 Dec 1976. Filed date 23 Dec 1974. 2p.

An accessory mountable within an automotive vehicle prevents the vehicle from catching on fire in case any wiring becomes shorted. The accessory consists of a block mountable anywhere in the engine compartment, the block supporting terminals connected to the battery and to the ground. One terminal has a pivotable throw arm contacting the other terminal. The battery entire electric output is passed through the accessory so that, if the throw arm is pivoted away to break the contact between the accessory terminals, the electric system of the vehicle is off.

39637 Battery separator. Hollenbeck, B.; Stockett, A.L.; Tate, J.L.; Simmons, D.M. (to W. R. Grace and Co.). US Patent 4,000,352. 28 Dec 1976. Filed date 1 Jun 1972. 10p.

A battery separator is provided that has a plurality of protrusions extending above its main surface. The protrusions are arranged in an entirely new pattern which permits a minimum total area of the separator to be covered with protrusions and yet assures good contact with all areas of a battery's grid. The protrusions are placed in alternating rows in a manner blocking any openings between protrusions with which an element of the battery's grid could be registered. Another aspect includes a compressible battery separator having compressible embossments. 6 figures.

39638 Method for making a nickel positive electrode for an alkaline battery. McBreen, J. (to General Motors Corp.). US Patent 4,000,005. 28 Dec 1976. Filed date 8 Jan 1976. 8p.

A nickel alkaline storage battery electrode can be made by vacuum impregnating a porous conductive support with a coagulum of nickel hydroxide, cobalt hydroxide and graphite particles entrained in a three-dimensional, reticulated, open-celled polyvinylidene fluoride binder, and thereafter compressing and drying the impregnated support. The coagulum is formed by mechanically suspending the hydroxide and graphite particles in a medium which is not a solvent for the polyvinylidene fluoride. In a separate operation the polyvinylidene fluoride is dissolved in a solvent which is only slowly soluble in the suspension medium for the particles. Then the polyvinylidene fluoride solution is added to, and intimately mixed with, the suspension in such a way that the polyvinylidene fluoride slowly precipitates and coagulates substantially uniformly throughout the solution—suspension mixture and entrains the particles therein as coagulation proceeds.

39639 Battery plate connection in SLI batteries. Howard, A.M. Warrendale, PA; Society of Automotive Engineers (1977). 7p. (CONF-770205—31).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The evolution of plate burning and cell interconnection of SLI batteries is followed from the older antimony—lead batteries to the newer maintenance-free batteries. The criteria for top lead selection for both types of batteries are compared. A new accelerated test for component evaluation is described and the laboratory results are discussed. 10 figures, 2 tables.

39640 Battery plate grid. Smith, C.H.; Dunning, K.G. US Patent 4,004,945. 25 Jan 1977. Filed date 6 Feb 1976. 4p.

This invention relates to a battery plate grid of the type that are cast from lead and which have a perimeter frame and a lattice network of bars formed integrally with the frame. The plate grid has protuberances spaced apart on one side only of the lattice network and formed integrally with it. The perimeter frame has a greater thickness than the lattice network, and the principal plane of the lattice network is between the spaced-apart planes of opposed face surfaces of the perimeter frame. The protuberances on one side of the lattice network have a height of about one-half the difference in thickness between the lattice network and the perimeter frame so that the outer extremities of the protuberances are in the plane of one face of the frame and serve to rigidify the lattice network during application of the paste. The tips of the protuberances show only at the surface of the paste when the grid is pasted, so that there is provided a thin construction that has relatively little lead surface exposed at the surface of the paste. 4 figures.

39641 Rechargeable electrochemical cell. Boter, P.A. (to U.S. Philips Corp.). US Patent 4,004,943. 25 Jan 1977. Priority date 19 Aug 1974, Netherlands. 2p.

A rechargeable electrochemical cell has an electrode which consists of a lanthanum nickel compound. A counterelectrode consists of a material which is capable of reversibly taking up and giving off an electron and a proton, such as nickel hydroxide or manganese dioxide. 1 figure.

39642 Electrochemical cell electrode separator and method of making it and fuel cell containing same. Witherspoon, R.R.; Domanski, E.M.; Davis, J.A. (to General Motors Corp.). US Patent 4,007,059. 8 Feb 1977. Filed date 20 Aug 1975. 10p.

An ion-permeable material particularly useful for electrode separators is discussed. The material is a uniform mixture of 30 to 70 percent by weight colloidal-size asbestos fibers and 20 to 40 percent by weight unsintered fine polytetrafluoroethylene fibers, bonded together with uniformly dispersed particles of a fluorinated ethylene—propylene copolymer comprising about 5 to 15 percent by weight of the material. Colloidal size particles of an alkaline earth metal oxide are dispersed throughout the material. The material is initially prepared in a modified paper making process and then heated to a temperature high enough to fuse the fluorinated ethylene—propylene copolymer but not high enough to sinter the polytetrafluoroethylene fibers. An improved zinc—air hybrid fuel cell and an improved silver oxide—zinc secondary battery are made possible with electrode separators such as these. 4 figures.

39643 Sheath for tubular storage battery electrodes and method for their production. Sundberg, E.G.; Westberg, E. (to Aktiebolaget Tudor). US Patent 4,008,100. 15 Feb 1977. Priority date 17 Dec 1973, Sweden. 8p.

A sheath for tubular storage battery electrodes has an inner layer of an inert fibrous material and an outer layer of thermoplastic material in the form of a net, perforated foil, or the like. The two layers are mechanically joined by heating the fibrous layer to a temperature sufficient to soften the adjacent surface of the thermoplastic material and cause a portion of the fibrous layer to be embedded in the surface of the thermoplastic layer. 9 figures.

39644 Pressure vent-sealed primary and secondary alkaline cells. Fitchman, A.; Wyatt, T.D. (to P. R. Mallory and Co., Inc.). US Patent 4,008,354. 15 Feb 1977. Filed date 12 May 1975. 6p.

An extrudable hot melt adhesive material is utilized in a low-cost vent for an electrochemical cell to relieve abnormal pressure formed during improper use of the cell. The extrudable hot melt adhesive material is suitably joined or bonded to a member used to provide a cell top, and covers and fills a vent hole formed in the member. Material is extruded through the vent hole by abnormal pressure to open the vent hole and allow the abnormal pressure to be released through the opened vent hole. The venting pressure can be predetermined by varying vent hole diameter, amount of adhesive, and the composition of the filler adhesive material with respect to viscosity. 3 figures.

39645 Storage battery comprising positive electrode of a graphite and lithium fluoride compound. Bennion, D.N.; Hebbar, R.K.; Deshpande, S.L. (to Secretary of the Navy). US Patent 4,009,323. 22 Feb 1977. Filed date 12 May 1975. 10p.

A positive electrode of a storage battery is formed by applying an electrical charge through a nonaqueous lithium perchlorate solution to an electrode formed of powdered "Madagascar"-type graphite and lithium fluoride. 1 table.

39646 Rechargeable electric accumulator cell with at least one zinc electrode. von Krusenstierna, O. (to Akriebolaget Tudor). US Patent 4,015,053. 29 Mar 1977. Filed date 1 Dec 1975. 4p.

An improvement in accumulator batteries having a zinc anode and an oxide cathode (e.g., nickel oxide or silver oxide cathode) is disclosed. The zinc anode and/or separator part between the anode and cathode is vibrated at a frequency and amplitude sufficient to inhibit dendrite growth on the zinc anode. The electrolyte contains excess zinc such that solid zinc oxide is present in the fully charged condition. The separator may be provided with circulation enhancement means. The resulting batteries have long life with a large number of charging and discharging cycles. 2 figures.

39647 Cyclic voltammetry on lead electrodes in sulphuric acid solution. Visscher, W. (Eindhoven Univ. of Tech., The Netherlands). *J. Power Sources*; 1: No. 3, 257-661(Apr 1977).

The oxidation of lead in 5 M H_2SO_4 was studied by cyclic voltammetry. When a potential scan is applied from 1.0-V to 2.6-V vs. R.H.E., the $PbSO_4/PbO_2$ oxidation peak can be observed in the anodic voltammogram provided the scan rate is 0.16 mV/s or lower. When the potential scan is restricted to the potential range +0.6 V to +2.6 V, the anodic voltammogram shows two peaks, which were assigned to the formation of α-PbO_2 and β-PbO_2, respectively. This α-PbO_2 is formed underneath the $PbSO_4$ film. During the reverse sweep the main reduction peak at 1.65 V corresponds with the reduction of β-PbO_2 to $PbSO_4$. α-PbO_2 is not reduced at a definite potential, but it is reduced to n-PbO.$PbSO_4$ with n increasing from the oxide—electrolyte interface towards the interior of the electrode and with more cathodic potential. At potentials below 0 V, the basic lead sulfates are reduced. The effect of the addition of small amounts of H_3PO_4 to H_2SO_4 electrolyte during the potential scanning results in an increase of the α-PbO_2 peak and a disappearance of the β-PbO_2 peak. 6 figures

39648 Discharge reaction mechanism of the MoO_3 electrode in organic electrolytes. Besenhard, J.O. (Technische Univ., Munich); Schoellhorn, R. *J. Power Sources;* **1**: No. 3, 267-276(Apr 1977).

Discharge and charge reactions of MoO_3 electrodes in organic Li^+ electrolytes are shown to be reversible topotactic redox processes of layered molybdenum bronzes Li/sub x/$^+$ [MoO_3)/sup x/$^-$ The kinetically accessible charge range amounts to 0.1 less than or equal to x less than 1.5 with the lower limit of x depending on the precedent cathodic load. Complete re-oxidation to the binary oxide is kinetically hindered, presumably as a result of small structural changes. The process is strongly affected by the size of the electrolyte cation, whereas no dependence on the anion species was observed. Reduction beyond $x = 1.5$ is at least partially associated with irreversible changes in the oxide structure. Similar reactions were found for non-stoichiometric molybdenum oxides, e.g., $Mo_{18}O_{52}$ and Mo_8O_{23}. 8 figures.

APPLICATIONS

REFER ALSO TO CITATION(S) 39777, 39778, 39779, 39780, 39781, 39783, 39785, 39786

ENERGY MANAGEMENT AND POLICY

REFER ALSO TO CITATION(S) 40723

39649 (ERDA—76-133) **Proposed plan for education and training in nonnuclear and nuclear energy technologies.** Vachon, R.I.; Griffith, D.E. (eds.). (Energy Research and Development Administration, Washington, D.C. (USA). Office of University Programs). Feb 1977. Contract EX-76-C-01-2432. 164p. Dep. NTIS $6.75.

This report presents the results of a systems approach by an ERDA/ASEE Task Force to a charge from the 94th Congress to the Energy Research and Development Administration to develop a plan for a comprehensive program for education and training in nonnuclear energy technologies. The PLAN as presented is the recommendation of the Task Force and is not to be construed as the ERDA Plan. The interpretation of the charge leads to the following definitive statements. The PLAN should consist of a program and organizational and administrative means within ERDA to develop and manage the program. The program should: (1) include general educational subprograms, vocational skill subprograms to degree and post degree programs; (2) include nuclear as well as nonnuclear education and training; (3) encourage, assist, and utilize all institutions from labor unions to universities to assure educated and trained manpower to meet the nation's energy needs; (4) be catalytic in nature and rely not only on funding as a catalytic agent but also on information and leadership; (5) give equal opportunity to all seeking or needing education and training to become a part of the energy labor market in all regions of the nation; (6) be supplementary to what can be accomplished by the private sector; (7) promote interaction between ERDA and other Federal government agencies and state and local governments; (8) be responsive as well as anticipatory; (9) be applicable from energy resource exploration to energy and use; and (10) provide for input and feedback from the private sector.

39650 (PB—260643) **Illinois program report of the Division of Energy. Final report.** Marder, S.A. (Illinois Dept. of Business and Economic Development, Springfield (USA). Div. of Energy). Nov 1975. 135p. Q 07/MF A01.

This report covers the history and administration of the Division of Energy from the formation of the Office of the Illinois Energy Coordinator to the Executive Order that created the Illinois Division of Energy in the Department of Business and Economic Development. It reviews the duties, responsibilities and functions of the various sub-divisions that comprise the Division of Energy. (GRA)

39651 (TID—4590) **Directory of ERDA information centers.** (Energy Research and Development Administration, Washington, D.C. (USA). Office of Technical Information). Mar 1977. 51p. TIC.

This Directory is published to bring to the attention of ERDA and its contractors and the scientific and technical community in general the services available at ERDA-operated or sponsored information centers in providing technical information. A description is given of the AEC centers carried over to ERDA plus all other centers now wholly or partially under ERDA sponsorship that the editor has been able to identify. Two centers operated by ERDA personnel are: ERDA Technical Information Center and Nevada Applied Ecology Information Center. Centers operated by ERDA contractors are: Advisory Center on Toxicology; Argonne Code Center; Berkeley Particle Data Center; Biomedical Computing Technology Information Center; Biomedical Sciences Section; Controlled Fusion Atomic Data Center; Ecological Sciences Information Center; Energy Research, Development and Demonstration Inventory; Environmental Mutagen Information Center; Environmental Resource Center; Information Center for Energy Safety; Information Center for Internal Exposure; LMFBR Fuel-Cladding Information Center; National Geothermal Information Resource; National Neutron Cross Section Center; Nuclear Data Project; Nuclear Safety Information Center; Radiation Chemistry Data Center; Radiation Shielding Information Center; Rare-Earth Information Center; Research Materials Information Center; Shock Wave Data Center; Table of Isotopes Project; Toxic Materials Information Center; and Water Resources Center.

SYSTEMS STUDIES AND TOTAL ENERGY

REFER ALSO TO CITATION(S) 39489, 39657, 39680

39652 (ERDA—77-13) **Application of net energy analysis to consumer technologies, February 1977.** Frabetti, A.J. Jr. (Energy Research and Development Administration, Washington, D.C. (USA)). 1977. Contract EX-76-C-10-3847. 371p. Dep. NTIS $10.50.

Utilizing a net energy methodology that examines both direct and indirect energy consumption, this report determines the overall energy resource consumption effects of satisfying several selected consumer demands for energy: a residential demand for the provision of heat, cooling, and hot water; a transportation sector demand to power an automobile; and an industrial demand for process steam and electricity. Energy consumption is described through the use of trajectories that, in modular fashion, trace from in-situ resource to the particular final demand. This allows the analyst to examine changing fuel forms in the supply path as well as changing technology in the user-demand path. The beneficial effects of the developing residential energy-use technologies are quantified, the flexibility of the electric automobile with regard to resource use is demonstrated, and the overall energy savings via on-site power generation are detailed. In particular, the study demonstrates the usefulness of the net energy methodology as a tool for assessing the true implications for fossil reserves when substituting different energy sources.

39653 (NP—21769) **Electricity and heat production: energy efficiency versus cost efficiency.** Lingard, P.A. (Central Electricity Generating Board, London (UK)). Aug 1975. 14p. U 01/MF A01.

The lecture is concerned with how much energy might be saved by combining public electricity supply with public heat supply and how much of other resources have to be utilized to achieve that saving. Only in the long term can worthwhile savings be achieved. To place any aims and achievements in a proper perspective, a look at a projection of national and European fuel requirements in the years ahead is needed. In the United Kingdom in 1985, a total of 400 million tonnes of coal, oil and gas and only 30 million tonnes of nuclear fuel (all expressed as equivalent tons of coal) is expected to be consumed. In the UK there is very little opportunity of obtaining electricity from water power. In the European Economic Community the nuclear proportion is expected to be higher at about 21 percent of the coal, oil and gas compared with only 7½ percent in the United Kingdom. The UK figures are included in the European figures. The difference between 21 percent and 7½ percent indicates the extent to which the UK is going to be later than Europe in developing nuclear power and later than Europe in any gains to be obtained from cheaper nuclear energy. This is only possible because of the advantage this country has in relation to coal, oil, and natural gas resources compared with Europe; and from the point of view of district heating this is an advantage. However, taking into accout the way in which nuclear is going to provide a much bigger share of the country's requirements for energy by the end of this century (only some 15 years after 1985) it must be borne in mind that electricity may displace other methods of heating.

39654 Use of system methods for the development of planning in the combustion energy industry in a country with a planned economy. Belyaev, L.S. *Rev. Energ.;* **27**: No. 286, 423-432(Sep 1976). (In French).

The aim of this article is to describe the principles of a systems method for the planning of development of a combustion energy industry in a country with a planned economy. In particular, this article refers to the experiences carried out in the USSR; it describes the results of research by the Siberian Institute for Energy of the USSR Academy of Sciences. This article is part of the Energy Project of the 'IIASA' which investigated the long-range (15 to 20 years) energy evolution in various countries (developed and developing countries with or without planned economies). This project also takes into consideration general constraints.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 39390, 39654, 39661, 39662, 39687, 39688, 39697, 39701, 39705, 40250

39655 (BNL—20916) **Analytical approach to the determination of urban population density gradients and its application to energy planning problems.** Meier, P.M.; McCoy, T.H. (Brookhaven National Lab., Upton, N.Y. (USA)). Oct 1976. Contract EY-76-C-02-0016. 65p. Dep. NTIS $4.50.

Important urban relationships depend on the spatial gradients of population density. Urban population density gradients prove to be important in nuclear energy facility siting, strategic targeting and civil defense, industrial planning, and many varieties of energy planning problems. Following the Introductory Section, Section II turns to a discussion of Clark's hypothesis, which forms the basis for the model of population density to be used in this essay. A method of estimating the parameters of the model is presented in Section III, with an analysis of error sensitivity presented in Section IV. In Section V, the difference between a uniform density specification for a given area and a density gradient formulation, using a calculation of pollutant dose from a centrally located power station as an example is examined. Extension of the model to urban areas of non-circular form is derived in Section VI, again with emphasis on the estimation of model parameters. Section VII presents a comparison of the traditional regression technique for parameter estimation with the numerical method developed in this paper. Finally, in Section VIII, the model is applied to a sample of energy planning problems, the screening of urban areas for suitability for district heating schemes, the computation of transportation costs in the recovery of energy from municipal refuse, and a preliminary formulation of a model of power plant location in urban areas. (MCW)

39656 **Nationally-linked economic forecasts for energy and environmental impact analysis.** Maki, W.R.; Venegas, E.C.; Turnquist, R.E. (Univ. of Minnesota, St. Paul). pp 774-780 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976). See CONF-760703—.

The Minnesota impact forecasting system is a modular approach to both economic modeling and information systems development. A set of modules—market, investment, demand, production (input-output), employment, value added, labor force, population, household, fiscal and ecologic—provide the data base and programming routines for simulating the state (or a substate regional) economy. An additional set of government function modules, including energy and environmental management, provides an auxiliary data base and forecasts for state and local government agencies. This series of data modules and related computer programs, locally called SIM-LAB, thus provides a readily accessible regional impact simulation laboratory for resource managers and policy analysis.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 39241, 39452, 39453, 39724, 39815, 40129, 40241, 40250, 40393, 40398

39657 (BNL—50567) **Multiobjective location analysis of regional energy facility siting problems.** Church, R.L.; Cohon, J.L. (Brookhaven National Lab., Upton, N.Y. (USA)). Oct 1976. Contract EY-76-C-02-0016. 94p. P 05/MF A01.

This report is one of a continuing series of policy analysis and model development studies in the area of energy facility siting prepared by the Brookhaven National Laboratory Regional Energy Studies Program. At Oak Ridge National Laboratory a sophisticated approach based on political interaction analysis has been developed as an adjunct to their siting model, allowing resolution of regional siting issues in the context of a prediction of political feasibility (Yaffee, 1976). And at Brookhaven, emphasis has been on the development of operations research approaches that could interface with the ensemble of energy systems analysis models resident at BNL's National Center for Analysis of Energy Systems, and the regional environmental impact models at the BNL Atmospheric and Oceanographic Sciences divisions (Meier, 1975). As an initial step in the development of such an operations research approach to regional siting policy analysis, this report presents an exploratory analysis of two areas of inquiry that appear especially promising. The first, examined in Chapter II, rests on the application of location theory, an area of inquiry that has seen a strong resurgence in the recent mathematical geography and regional economics literature as a result of its ability to address a rather large number of facility planning problems, in both the private and public sectors. The second area of inquiry, the focus of Chapter III, is multi-objective programming, a formalization of the notion that siting decision making is an adversary process, in which a resolution of conflicting objectives is the key issue. Multi-objective location modeling, a merger of the two areas of inquiry, may provide a useful analytical framework for regional energy planning. The Regional Energy Facility Location Model, which is based on such a merger, is presented in Chapter IV, and various extensions of the basic model formulation are presented in Appendices.

39658 (TID—27444) **Energy Technologies for the West: possible effects of energy technology on land, water, and air resources. Workshop held in San Francisco, California, 21 September 1976.** (Energy Research and Development Administration, Washington, D.C. (USA)). 1976. 81p. P 05/MF A01.

John Fraser, Association of California Water Agencies, spoke on the effect of energy technology on California's water resources. He pointed out that by the year 2000, a water deficiency of about 2,250,000 acre-feet will exist in California; therefore, many agencies will not indefinitely commit supplies of fresh water for power plant cooling. Legislation for siting power plants along the coastline is summarized. Dr. James Liverman, ERDA, noted a remark by Mr. Fraser that, in its national plan, ERDA "does not appear to pay much attention to the water issue"; he agrees, but says ERDA is committed to working with the Water Resources Council, with establishments in each state. Professor Robert Hagan, Univ. of California, reports on a program to investigate the energy required to develop water, or, in short, to move water to where it is to be used; water which may be associated with the use and conservation of water; the energy associated with waste-water treatment; and waste-water reuse. Speaker Zock Willey, Environmental Defense Fund, briefly evaluated the environmental impact of an energy technology by saying that the public has a right to know and say what the risks are in terms of the trade-offs. Russ Freeman, EIA, says he doesn't believe it possible to have an energy program in the traditional concept of a government program. EPA has learned that energy is an input to every societal process and pollution is an output from virtually everything that society does. The final speaker, Fayne L. Tucker, Lake County Air Pollution Control District, reviewed the potential of geothermal resources, saying that it is believed the Lake County government can, with the state and Federal government, plan geothermal development. It is also believed the Geysers should be considered as a payoff area. An extensive question and answer session completed the workshop. (MCW)

39659 **Illinois land: the emerging conflict over the use of land for agricultural production and coal development.** Ostendorf, D.L.; Gibson, J.E. Carterville, IL; Illinois South Project, Inc. (1976). 37p.

With conflict emerging in Illinois over the allocation of land for growing food and for producing coal and energy, the citizens need to become familiar with the trade-offs they may select as they face the world food and energy crises. Illinois, the nation's leading farm export state, needs to explore the political and social ramifications of how its agricultural products are distributed. As the fourth ranking coal-producing state, land use conflict is inevitable with both industries expanding to meet national and world demand. This booklet documents the impact of both industries on land allocation, production, environment, social structure, and economy. The choices are critical because, to a large extent, they are irreversible in spite of land reclamation programs. Active citizen input is urged to offset the strength of government and corporate interests. A course of action is outlined that will restrict the encroachment of energy development on valuable agricultural lands by setting a moratorium on the portion of land that must be kept in soil conservation categories. A profile is drawn of each county's land investment in coal and agriculture. 62 references. (DCK)

39660 **Industry's dilemma: balancing energy savings with pollution control.** *Commer. Am.;* 2: No. 6, 8-10(14 Mar 1977).

Two Department of Commerce studies conducted by the Office of Environmental Affairs indicate that energy conservation efforts by several major industries will be substantially offset by the energy requirements for meeting environmental standards. The first study explored the energy needed by each industry for pollution control, while the second evaluated the effects alternative policies could have and examined the potential energy-conserving technologies available until 1983. Results of the studies are described for the iron and steel, primary aluminum, pulp and paper, and the fossil-fuel steam electric-generating industries. Pollution control is estimated to require a 10 percent increase in energy use for iron and steel, 5.5 percent for pulp and paper, 4.4 to 8.5 percent for fossil-fuel plants, and 2.8 to 8.5 percent for aluminum. Federal goals of from 10 to 27 percent energy savings have been set for major energy-intensive industries, but conclusions from these studies indicate that the goals cannot be met without resorting to some of the suggested economic and environmental trade-off possibilities. (DCK)

ENERGY RESOURCES

REFER ALSO TO CITATION(S) 39375, 39376, 39658

39661 (PB—259204) **Growing natural resource scarcity. Final report.** Brown, G. Jr.; Field, B. (Washington Univ., Seattle (USA).

Dept. of Economics; Massachusetts Univ., Amherst (USA). Dept. of Food and Resource Economics). 1976. 40p. Q 03/MF A01.

Prepared in cooperation Massachusetts Univ., Amherst. Dept. of Food and Resource Economics.

The objectives of this research program were to examine and evaluate alternative measures of natural resource scarcity. The analysis studied three economic measures of natural resource scarcity: the unit cost of resource-intensive extractive output, the price of natural resource intensive products, and the rental rate of natural resources. The authors also explored the application to natural resources of new techniques for estimating the elasticity of substitution between natural resources and other inputs used to produce goods and services. The elasticity of substitution, while not a scarcity indicator, gives some feel for the difficulty of adjusting to growing natural resource scarcity. (GRA)

39662 State energy budgets and energy multipliers for the Rocky Mountain states. Sathaye, J.A.; Kunin, L. pp 781-783 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

The Rocky Mountain Region contains a large portion of the nation's energy reserves. The eight states which make up the region will bear the brunt of increased energy-related activities over the next several decades. In order to understand the likely impacts of energy-related developments on the regional economies involved, the economic structure of the state economies through interindustry (input-output) analysis was simulated.

RESEARCH AND DEVELOPMENT

REFER ALSO TO CITATION(S) 39654, 39671, 39689

39663 (SAND—77-0034) **Sandia Laboratories energy programs.** Lundergan, C.D.; Mead, P.L.; Gillespie, R.S. (eds.). (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1977. Contract EY-76-C-04-0789. 55p. P 04/MF A01.

As one of the multiprogram laboratories of the Energy Research and Development Administration, Sandia Laboratories applies its resources to a number of nationally important programs. About 75 percent of these resources are applied to research and development for national security programs having to do primarily with nuclear weapons—the principal responsibility of the Laboratories. The remaining 25 percent are applied to energy programs and energy-related activities, particularly those requiring resources that are also used in nuclear weapon and other national security programs. Examples of such energy programs and activities are research into nuclear fusion, protection of nuclear materials from theft or diversion, and the disposal of radioactive waste. A number of technologies and disciplines developed for the weapon program are immediately applicable for the development of various energy sources. Instruments developed to detect, measure, and record the detonation of nuclear devices underground, now being used to support the development of in-situ processing of coal and oil shale, are examples. The purpose of this report is to provide an overview of these and other energy programs being conducted by these laboratories in the development of economical and environmentally acceptable alternative energy sources. Energy programs are undertaken when they require capabilities used at the Laboratories for the weapon program, and when they have no adverse effect upon that primary mission. The parallel operation of weapon and energy activities allows optimum use of facilities and other resources.

39664 (TID—27407) **Energy-related multidisciplinary research at universities. Report on the ERDA—University workshop held April 28—30, 1976, in Keystone, Colorado.** (Denver Research Inst., Colo. (USA)). 1 Oct 1976. Contract E(49-18)-2466. 46p. P 03/MF A01.

This workshop at the Keystone Center for Continuing Education, Keystone, Colorado discussed questions associated with the ERDA development and support of multidisciplinary energy-related programs at universities. The major objectives of the workshop were (1) to review and examine the past development and conduct of multidisciplinary programs as guidance to both ERDA and the educational community in the design of future programs for ERDA consideration; (2) to present and examine current ERDA policies, programs, and operations related to the support of multidisciplinary research at universities; (3) to develop and suggest new approaches, if required, which would encourage and support the development of such new programs both within ERDA and the universities; and (4) to identify other selected issues of mutual concern. Some participants expressed the view that U.S. energy policy and ERDA's responsibilities under that policy lack coherency and do not represent an appropriate response to the nation's energy needs. (MCW)

39665 1976 energy research and development inventory for the State of Missouri. Jefferson City, MO; Missouri Energy Agency (1976). 25p.

The Missouri Energy Agency has compiled an inventory of 150 statewide R and D projects involved with energy as a first step in opening communications channels between groups involved. The projects will be kept informed of research activities and funding opportunities. Most funds originate with ERDA and the National Science Foundation, with contributions from the Electric Power Research Institute, Gas Research Institute, et al. Projects are listed in broad categories of agriculture, electric energy analysis and utilization studies, fossil fuel, nuclear energy, solar, wind, miscellaneous, and pending. Listings include the organization, names of principal investigators, title of project, funding source, dollar amounts, and duration of project. Programs in electric, fossil fuels, and energy analysis and utilization studies are emphasized. Most projects, with the exception of those pending, are scheduled to be completed before 1980. (DCK)

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 39450, 39535, 39570, 39649, 39682, 40398

39666 Nuclear power: issues and outlook. Morse, J.G. (Colo Energy Res Inst, Golden). *Colo. Sch. Min., Miner. Ind. Bull.;* **19**: No. 6, 1-10(Nov 1976).

A large reduction in the present U.S. dependence on imported oil will dictate more extensive use of coal and uranium for the production of electricity. There are risks associated with the use of each, but nuclear energy lies at the epicenter of the present-day environmental-energy controversy. The author examines nuclear power's five prime issues and attempts to put them into reasonable perspective. The issues are: allowable radiation release from normal reactor operation; the potential of a large-scale release; sabotage of nuclear power plants; waste disposal; and weapons proliferation. These risks are contrasted with those inherent in using coal-fired and hydroelectric plants, and it is concluded that nuclear power is by far the safest available power option. 14 refs.

39667 Atomic energy legislation through 94th Congress, 2d Session. Washington, DC; Joint Committee on Atomic Energy (1977). 554p. GPO $4.60.

Statutes and material pertaining to atomic energy legislation are compiled for the benefit of the Joint Committee on Atomic Energy and for public information. Legislation includes The Atomic Energy Act of 1954 (as amended); the Energy Reorganization Act of 1974; Atomic Energy Commission Authorization Act (with amendments) for fiscal years 1956 through 1977; Nuclear Regulatory Commission Authorization Acts for fiscal years 1975 through 1977; ERDA Authorization Acts for fiscal year 1976, including supplemental; the Euratom Cooperation Act of 1958 and the Concurrent Resolution; the International Atomic Energy Participation Act of 1957; and the Atomic Energy Community Act of 1955 (as amended). 90 references. (DCK)

39668 Energy policy and energy projections: the case of a nuclear moratorium. Weinberg, A.M.; Whittle, C.E. (Oak Ridge Associated Universities, TN). *Nucl. News;* **20**: No. 4, 44-48(Mar 1977).

From AIF conference on United States energy policy; Washington, DC, USA (11 Jan 1977).

An inability to predict the future, especially noticeable in the process of setting energy policy, underscores the need to place a moratorium on nuclear energy programs until institutional and policy changes are devised to make a nuclear future acceptable. There was a reluctance to take problems of waste disposal and fuel cycle seriously in the early days, with the result that the front end of breeder technology has developed faster than the back end. Funded by ERDA through the National Research Council, The Institute for Energy Analysis (IEA) examined the economic and environmental effects of a nuclear power moratorium. Results of the IEA study concur with the Ford Foundation's concept of Zero Energy Growth, but differs in its projections of a strong shift from oil and gas to electricity and coal. Projected energy needs were lower (101 to 126 quads by the year 2000) than earlier projections based on a world of abundant cheap energy that no longer exists. Instead, the IEA foresees a lower population, slower labor productivity, lower ratio of energy to Gross National Product, and higher energy efficiency. Effects of a nuclear moratorium will make it difficult to meet increased demand for electricity and cause some economic dislocations from the shift to coal. The pressure on the coal industry to increase production will have serious social, economic, and environmental impact. The increase in carbon dioxide concentration in the atmosphere will be of particular concern. Solar energy, which is not seen as a potential primary energy source, will not justify a cancellation of nuclear development. Energy parks (with co-located

fabrication and processing) run by an elite corps of nuclear experts may be the way to minimize hazards and establish an acceptable nuclear economy. (DCK)

TRANSPORT AND STORAGE

39669 (ANL/ES—55) **Strategies for commercializing customer thermal-energy storage.** Nelson, S.H. (Argonne National Lab., Ill. (USA)). Dec 1976. Contract W-31-109-ENG-38. 80p. P 05/MF A01.

This report presents strategies for commercializing customer thermal storage. Four storage techniques are evaluated: space heating, air conditioning, hot-water heating, and interruptible hot-water heating. The storage systems involved store off-peak electric energy for thermal applications during peak load hours. Analyses of both storage techniques and principal parties affected by storage indicate four barriers: the absence of (1) commercially available air conditioning storage devices, (2) appropriate rates, (3) information on both rates and devices, and (4) widespread utility support. Development of appropriate rates is the key to commercialization. The criteria used to evaluate rate types are: maximum combined utility and customer benefits, ease of commercialization, and practical feasibility. Four rate types—demand charges, time-of-use rates, and two forms of load management rates (a monthly credit and an off-peak discount)—plus the possibility of utility ownership are considered. The best rate types for each storage option are: for hot-water heating, a monthly credit for allowing utility interruptions or an off-peak price discount for storage; for space heating, an off-peak discount contingent upon meeting utility requirements; and for air conditioning, an off-peak discount plus monthly credit.

CONSERVATION

REFER ALSO TO CITATION(S) 39650, 39653, 39660, 39679, 39699, 39711, 39721, 39722, 39724, 39734, 39735, 39737, 39839

39670 (DHEW(HRA)—77-614) **Total energy management for nursing homes and other long-term care institutions.** (Department of Health, Education, and Welfare, Rockville, Md. (USA)). 1977. 67p. Dept. of Health, Education, and Welfare, Rockville, MD.

The purpose of this publication is to provide the basic instruction needed to implement the most effective form of energy conservation—Total Energy Management, or TEM—in your long-term care facility. The effort required is worthwhile for many different reasons: TEM is self-paying; TEM promotes energy conservation without negative impact on health care services; and energy costs will continue to escalate. Following the introductory chapter, chapters are titled: Understanding Energy Consumption; Initiating a Total Energy Management Program; Developing Energy Consumption Data; Conducting the Facility Survey; Developing and Implementing the Basic Plan; Communication and Motivation; Monitoring Your Program and Keeping It Effective; and Guidelines for Energy Conservation. Two appendices furnish information on building information for TEM and sources of information for energy management. (MCW)

39671 (ERDA—77-57) **Program plan for ERDA's participation in the IEA Working Party on Energy Conservation Research and Development.** (Energy Research and Development Administration, Washington, D.C. (USA)). Feb 1977. 118p. P 06/MF A01.

The International Energy Agency was formed in the aftermath of the 1973 oil embargo by the United States and other members of the Organization for Economic Cooperation and Development (OECD) interested in working cooperatively to ensure adequate future supplies of energy. The Energy Research and Development Administration is responsible for coordinating the United States involvement in IEA's energy conservation research and development, which is administered by the Working Party. This document represents the Fiscal Year 1977 program plan for ERDA's participation in the Working Party on Energy Conservation R and D. The purposes of this program plan are to: (1) provide guidelines for United States participation in the Working-Party program for use by ERDA and other Federal agencies interested in cosponsoring R and D activities; (2) identify the Working-Party project areas in which ERDA and other Federal agencies are presently participating, specifying financial commitments; and (3) identify the Working-Party project areas in which ERDA and other Federal agencies are planning to participate, specifying financial commitments. The plan outlines specific goals and criteria for United States participation in the Working Party, and presents the current and planned participation of ERDA and other Federal agencies.

39672 (FEA/D—76/374) **Second quarterly report to U.S. House and Senate Committees on Appropriations.** (Federal Energy Administration, Washington, D.C. (USA). Office of Energy Conservation and Environment). Jul 1976. 33p. Federal Energy Administration, Washington, DC.

This is the second in a series of quarterly reports to the House and Senate Committees on Appropriations describing the progress of the Federal Energy Administration's (FEA) energy conservation programs and short- and long-term accomplishments. FEA's energy conservation programs are conducted by the Office of Energy Conservation and Environment. EC and E's energy conservation programs are directed towards five major targets: the three major end-use consuming sectors (residential/commercial, industrial, and transportation), utilities, and the Federal government. The previous quarterly report (April 1976) reviewed the percentages of the total energy that was consumed by each sector in 1974; data for 1975 are presented in this report. Compared to energy consumption in 1974, residential and commercial consumers used less primary energy but more electricity in 1975. Industrial consumers used less primary energy as well as less electricity than in 1974. The result is that in 1975 the residential/commercial sector replaced the industrial sector as the largest end-use consumer of energy. Part A, Overview, briefly describes the programs, focusing on new programs and significant changes in the scope of existing programs. Part B, Highlights, reports the current status of the programs, including indicators of energy consumption and conservation, and major activities conducted during the reporting period. Part C lists new publications. (MCW)

39673 (LA—6569-MS) **Accounting systems for energy conservation.** Barrett, R.J.; Becker, M. (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1976. Contract W-7405-ENG-36. 10p. P 02/MF A01.

It has been found that existing methods of accounting for energy consumption are not well suited to the analysis of energy conservation programs. A thorough discussion is presented of what the characteristics of an energy conservation data base ought to be. A data base (GADFLY) is suggested, which would be designed for analysis of conservation policies. Using New Mexico as an example, the difference between GADFLY and the Federal Energy Administration's STRAWMAN data base are detailed.

39674 (LBL—5996) **Promoting energy conservation through occupational licensure: a feasibility study.** Wilms, W.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1977. Contract W-7405-ENG-48. 21p. P 05/MF A01.

To achieve energy conservation measures in buildings' power and lighting systems, landscaped spaces, parks, freeways, building sites, etc., the responsible engineers and tradespeople will have to be educated in ways to conserve energy. This report analyzes a key way of intervening in such education and training to promote energy conservation through the State licensing process. This study rests on the assumption that if candidates for State licenses were tested on their knowledge of energy conservation, each licensee would know how to conserve energy through his or her chosen profession. The study also assumes that, once licensing examinations include questions on energy conservation, the ways in which people are trained for occupations that affect energy use would change rapidly+. It was assumed that if candidates were tested on their knowledge of energy conservation, training institutions (colleges and universities) and publishers would institutionalize energy conservation in their curricula and publications to prepare candidates for the examinations, which would achieve a long-term structural change. The objectives of this study are: to identify approximately five licensed occupations, which because of their size or function, can promote energy conservation; to assess the extent to which energy conservation is already part of the licensing process; to assess the feasibility of amending the licensing procedure in those occupations to highlight energy conservation; and to recommend strategies to bring energy conservation into the licensing process. Seventeen boards were initially identified to have an impact on energy conservation, but were narrowed to these five areas: architecture, engineers, contractors, landscape architecture, and accounting. Specific data for California were used for the study. (MCW)

39675 (PB—261162) **Highlight report. Volume XXI. Driving and energy conservation.** (Opinion Research Corp., Princeton, N.J. (USA)). Mar 1976. Contract FEA-CO-04-50236-00. 28p. (ORC—25008-Vol-21). Q 03/MF A01.

See also PB—261163.

A nationwide probability sample survey of 1,207 respondents was conducted by ORC by telephone during the period November 26 through December 21, 1975. These data indicate that most drivers drive in ways that save gasoline. Ninety-six percent stop pressing gas pedals when they see a red light; 84% plan several errands for one trip; 84% have car engines tuned once a year (increases cars' mileage); and 84% drive 55 mph on major highways (this speed saves gasoline). The exception is that 69% drive themselves to work; only 10% carpool or take passengers, 8% take public transit, and 5% walk to work. (GRA)

39676 (PB—261163) **Highlight report. Volume XXII. Energy-saving behavior around the home.** (Opinion Research Corp., Prince-

ton, N.J. (USA)). Apr 1976. Contract FEA-CO-04-50236-00. 29p. (ORC—25008-Vol-22). Q 03/MF A01.

See also PB—261164.

A nationwide probability sample survey of 1,016 respondents was conducted by ORC by telephone during the period December 30, 1975 through January 15, 1976. Most people's home use of energy is tied to their beliefs regarding what constitutes energy saving. Data in this report on people's use of home heating, insulation, electric lights, water heaters, and washers, dryers, and dishwashers tend to support this observation. Forty-nine percent set their thermostats below 69C during the day and 15% at or below 60 deg. at night; 79% say their homes are insulated; 55% turn lights off when they leave a room for a short time; 42% do not know at what temperature their water is being heated. Results show that beliefs about energy consumption affect the way people behave; therefore, people should be informed of the more energy-efficient ways to behave through public education efforts. (GRA)

39677 (PB—261164) **Highlight report. Volume XXIII. Parents' perceptions of their children's sources of energy information and energy-related activities.** (Opinion Research Corp., Princeton, N.J. (USA)). Apr 1976. Contract FEA-CO-04-50236-00. 33p. (ORC—25008-Vol-23). Q 03/MF A01.

See also PB—261165.

A nationwide probability sample survey of 1,002 respondents (606 of whom were living in households with children under 18 years who were attending school) was conducted by ORC by telephone during the period January 27 through February 25, 1976. This report indicates that a substantial amount of energy information has been transmitted to American homes by children who obtain such information in school. This information dealing with energy conservation is welcomed. In home energy saving, parents are interested in home heating and lighting information. Parents would like more information on saving gasoline. Parental behavior and attitudes are reflected in children's behavior and attitudes and vice versa. Most people feel sponsorship of energy-saving school programs by utility companies or government as appropriate. Children's TV programs, publications, and organizations are seen as good means of communicating energy information to children. (GRA)

39678 (PB—261165) **Highlight report. Volume XXIV. Understanding of the energy situation and evaluation of alternative actions.** (Opinion Research Corp., Princeton, N.J. (USA)). May 1976. Contract FEA-CO-04-50236-00. 23p. (ORC—25008-Vol-24). Q 02/MF A01.

See also PB—261161.

A nationwide probability sample survey of 1,203 respondents was conducted by telephone by ORC during the period March 22 through April 19, 1976. After two years of the energy shortage, nearly one person in eight (13%) does not believe it is a real problem, and only 5% see the energy problem as U.S. dependence on foreign oil supplies. People would rather save energy around the home in ways that do not entail physical discomfort--they would rather weatherproof the home than raise the setting of air conditioners or lower thermostats. Consumers appear responsive to 'life-cycle' pricing information in terms of purchasing choice. Income tax credits are more potent incentives than guaranteed bank loans for getting homeowners to make energy conservation home improvements. People want the Government to provide them with information on how to save energy. (GRA)

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 39184, 39656, 39662, 39685, 39688, 39742

39679 (BNL—50550) **Perspective on the energy future of the Northeast United States.** Brainard, J.; Davitian, H.; Goettle, R. IV; Palmedo, P.F. (Brookhaven National Lab., Upton, N.Y. (USA)). Jun 1976. Contract EY-76-C-02-0016. 217p. P 10/MF A01.

This study was undertaken to examine the implications of alternative energy futures for the northeastern U.S. First, the past and present energy supply and demand patterns for the U.S. and the northeast region are reviewed. Then, on the basis of detailed analyses of present and possible future supply and demand activities, scenarios for the years 1985 and 2000 are constructed and compared to examine the implications of various policies that will affect future supply and demand activities. Economic and environmental consequences are also discussed. The principal findings of the study are these: (1) conservation measures can reduce fuel and resource requirements in the northeast by over 30 percent; (2) oil imports are likely to continue to be a major energy resource for the northeast since only if strong conservation measures are combined with large increases in U.S. energy supplies is there apt to be a substantial decline in oil imports to the region; (3) a shift to coal and other alternate energy supplies, coupled with increased conservation, could compensate for a curtailment in the use of nuclear power in the region; (4) new resource technologies are capable of supplying up to 20 percent of the region's energy requirements in 2000; (5) no single supply technology or single conservation strategy taken alone can reduce the region's increasing dependence on foreign oil. Rather, the creation of an acceptable energy system for the region will require efforts in many directions in terms both of reducing demand and developing reliable, diversified supplies.

39680 (EPRI-EA—298) **Energy input—output modelling: problems and prospects. Final report.** Griffin, J.M. (General Electric Co., Washington, D.C. (USA). Center for Energy Systems). Nov 1976. 124p. P 07/MF A01.

A proliferation of research, part of which focuses on the relationship between energy and other sectors of the macroeconomy, has been witnessed. One outgrowth of this research has been energy input-output (I-O) tables, which, unlike conventional I-O tables, focus on physical flows of energy through the macroeconomy. The first concern of this paper is to investigate the methodological differences and empirical justification for the use of physical energy I-O coefficients as opposed to conventional I-O coefficients, which rely on real dollar flows. The second concern of this paper is to review energy-oriented applications of I-O analysis. These include applications based on physical and on real dollar flows. These studies range from static energy I-O coefficient analysis of the Btu content of an auto to efforts to dynamize I-O models by allowing the coefficients to change in response to relative prices and technology. These latter studies are particularly interesting in that the coefficient modelling techniques range from process-oriented optimization techniques to new econometric techniques. A third focus of the report is to analyze how energy I-O coefficients might be utilized with respect to the Wharton Annual Model. In this regard three alternative applications are investigated and a research strategy is suggested.

39681 (LBL—5928) **Analysis of the California energy industry.** Sathaye, J.; Ruderman, H.; Sextro, R.; Benenson, P.; Kunin, L.; Chan, P.; Kooser, J.; Ben Dov, Y.; Green, B.; Clear, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1977. Contract W-7405-ENG-48;CSERCDC-4-0072. 169p. P PC A08/MF A01.

The energy-supply system for California is an integral part of the state's economy, both in terms of energy as a commodity and in the economic effects of expanding requirements for new capital and man-power in the energy sector. It is this notion of an expanding energy system that forms one of the motivations for many of the energy policy discussions and formulations currently taking place. Some of the questions to be addressed are (1) if the energy system is to expand, by how much, and in what particular areas of supply; (2) what are the policy ramifications of certain changes as opposed to others; and (3) what are the major economic effects of changes in energy supply system plans. The purpose of this study is to: (a) describe quantitatively the California energy industry and its relationship to the California and U.S. economies; (b) provide the analytic capability for determining the direct and indirect employment and income impacts resulting from a given energy future for California, and (c) demonstrate and test the methodology with scenarios that embody varying combinations of conventional energy technologies, new energy technologies and energy conservation measures. The methodology developed is generally applicable to any set of specified changes. In this report three alternative energy futures for California are selected in order to quantify their resulting economic impacts.

39682 **Possible contribution of electrical energy to an improvement of European energy balances.** Laigroz, J.; van den Damme, R. (Electr de Fr, Paris). *Rev. Energ.;* 27: No. 285, 378-391(Jul-Aug 1976). (In French).

A brief review of the development of energy resources in the last two centuries is followed by a justification of the urgent need for Europe to develop nuclear capability for the production of electricity as the main energy source in the future. Various types of primary energy are surveyed and their possible use is evaluated. Consumption of electricity within the total consumption of energy is analyzed. Problems of realization of an electronuclear program are discussed. It is concluded that close cooperation between different sectors nationally and internationally is required for its realization.

39683 **Prospects for U.S. energy self-sufficiency.** Nelson, T.W. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1976). 7p. (CONF-761008—85).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Reliance on foreign oil imports and the fact that it is increasing steadily is unsound both for the U.S. economy and national security. Despite recent efforts to promote energy conservation and efficiency, demand for energy is expected to continue to rise with economic growth, increase in population, and improvement in envi-

ronmental conditions and living standards. Therefore, to avoid even greater reliance on imports domestic energy production must increase. U.S. oil and gas production will supply a smaller and smaller percentage of U.S. oil and overall energy demand; then coal and nuclear energy, and later solar and synthetic energy sources will have to be developed. A sound national energy policy must be developed Mr. Nelson feels, to eliminate waste in energy use and to encourage greater exploration and production of gas and oil, better use of coal and nuclear energy, and the development of solar and synthetic energy. At the same time, to encourage exploration in the U.S. as well as a smooth flow of the imports that is needed, he says national policy should foster a strong oil and gas industry, working free of the threat of discriminatory legislation, including divestiture legislation, and price controls which create negative incentives.

39684 Energy prospects in the Netherlands. Latzko, D.G.H. (Delft Univ. of Tech., Netherlands). *Delft Prog. Rep.;* 1: 1-24(Dec 1976).

The world situation on energy supplies is surveyed briefly, including problems that might arise concerning production and transport; then, the energy situation in the Netherlands is treated. For the purpose of this article, only relevant primary sources of energy, those whose large-scale utilization had been demonstrated to date, viz., fossil fuels, hydroelectric power, uranium in light-water reactors, and solar radiation came up for discussion. For the pronounced growth in total consumption the model proposed by A.A. De Boer (Econ. Statist. Rep., 59, No. 2954, 469-71(1974)) and inspired by the Dutch economist Prof. Tinbergen was adopted. This model assumes a gradual decrease in the annual growth to 1 or 2 percent about the year 2012. On the basis of this model, meeting the resultant demand for energy until the turn of the century is investigated.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 39657, 39667, 39668, 39674, 39713, 40129, 40393

39685 Energy strategy for Canada: policies for self-reliance. Ottawa; Minister of Energy, Mines and Resources (1976). 178p. Printing and Publishing Supply and Services Canada, Ottawa, Canada K1a 0S9 $3.00.

The Canadian government outlines its National Energy Strategy for Self-Reliance, which combines a number of energy policies into a comprehensive plan with specific targets for the next 10 to 15 years. Policies passed in the 1973—1975 period are reviewed in order to present the current energy situation and explain the approach Canada will take to deal with it. The government has identified several energy policy areas, including appropriate pricing and conservation; ways to increase exploration, research, development, and resource information; new systems for delivery and interfuel substitution; emergency preparedness; and greater Canadian participation. Two scenarios serve as the basis for a series of conclusions, from which a policy strategy is developed. Targets are set to (1) equalize domestic oil prices with international prices and gas with oil in two to four years; (2) reduce energy growth rate to 3.5 percent per year in 10 years; (3) reduce demand for imported oil to one-third the total demand by 1985; (4) remain self-reliant in natural gas until market conditions are acceptable for northern resources; and (5) double efforts in the next three years to explore and develop frontier areas in ways that are socially and environmentally sound. (DCK)

39686 Energy as a factor in Soviet foreign policy. Russell, J. Lexington, MA; D. C. Heath and Company (1976). 263p.

Not much information is disseminated concerning Soviet energy capability, but an attempt is made to provide an up-to-date review about the Soviet and East European energy situation. Does the Soviet Union have an energy problem. Is it, or are its Comecon allies, also affected by the energy crisis affecting almost all other countries, and to what extent. Does the Soviet Union have large reserves of energy, and if it does, can it develop these by itself or will it require western help. Could the Soviet Union ever become a major exporter of energy to the rest of the world or will it, too, ultimately become a substantial importer of middle eastern oil, like so many of its ideological opponents. If the Soviet Union does have energy problems, either now or in the future, are they such as to encourage the Soviet leadership to attempt to influence the course of world events in one direction or another. What could be the constraints upon the Soviet Union in such an event, and what course of action might the rest of the world contemplate by way of a response. These are some of the questions which will be looked at in this book. It will not be possible to give exact answers to any of them in view of the essentially "Western" criteria which must, of necessity, be employed in their analysis (in the absence of any clear-cut official Soviet commentary on the subject). The guidelines for the 1976—1980 five-year plan were published as the book was going to print. Oil production is targeted at 620 to 640 million tons, coal at 800 million tons, and gas at 400 to 430 billion m^3. Energy conservation will likely be emphasized, but the overall rate of energy consumption is unlikely to fall below the annual 5 percent rate. (MCW)

39687 Simulation of a regulatory commission. Fletcher, D.O.; Karian, Z.A. (Denison Univ., Granville, OH). pp 639-643 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

A computer simulation model of a public utility commissioner's task in regulating a typical public utility is discussed. The programming language used was BASIC-PLUS and the model was implemented on a PDP $^{11}/_{45}$ computer with 104 K words of memory and 16 of 25 available terminals dedicated to a student body of 2100. The primary purpose of the model is to enable economics students to appreciate the inherent difficulties in sustaining a healthy industry while keeping the public satisfied through regulation. The object is to give the student the feel of being a regulator and present him with some of the problems and constraints felt by a conscientious regulator.

39688 Regional model for energy analyses. Thomas, R.W.; Schuler, G.E. (Univ. of Houston, TX). pp 784-787 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

An econometric model of the Houston-Galveston Metropolitan Area has been developed. The primary purpose of the model is to serve as an instrument of analysis for energy policymaking. The usefulness of the model for this purpose has been enhanced by specific design features. Houston energy production is linked to national demand conditions. The pattern of industrial, commercial and residential energy use is depicted in detail. Every attempt is made to relate supply and demand to relative prices, so that taxation and other price related strategies may be simulated. The regional model is linked to a national economic model, so that world and national policy impacts on the local area can be adequately captured.

39689 Seamans likes most of the changes but warns of pitfalls in management. *Energy Res. Rep.;* 3: No. 6, 4-5(21 Mar 1977).

Robert C. Seamans, Jr., former Administrator of ERDA, discussed his reactions to the Carter Administration's approach to energy policy and government reorganization in an interview. Seamans supports the emphasis on conservation, the concept of a Department of Energy, Congressional moves to reorganize its energy components, and the overall serious approach to energy. His major concerns are the reduced support for fusion, breeder, and solar electric programs, all of which are too far in the future to attract private investment, and the downgraded technical administration for research and development, which could limit management effectiveness. Seamans, now a consultant to ERDA, comments on the intertwining of ERDA, Federal Energy Administration, and Federal Power Commission personnel and functions. He notes that a separate appeals board will allow proper separation of management and regulation. (DCK)

FOSSIL FUELS

REFER ALSO TO CITATION(S) 39382

39690 (BNL—21995) Volumes and transportation costs of fossil fuels shipped between Census Regions. Shaw, M.L.; Wood, R.K. (Brookhaven National Lab., Upton, N.Y. (USA)). Oct 1976. Contract EY-76-C-02-0016;SUB-391492. 50p. P 07/MF A01.

Regional transportation options and costs of transmitting present and future energy sources influence selective choices. A multi-regional model permits energy policies to be addressed at a regional level of disaggregation. A multi-regional linear programming model of the nation's energy system is currently being developed at the National Center for Analysis of Energy Systems, Brookhaven National Lab. The two essential components providing the analytical power to such a model are: (1) an adequate representation of the regional cost structure of energy transportation, and (2) region-specific resource-supply functions. In support of these modeling activities, the Logistics Management Institute (LMI) has derived the volumes and transportation unit costs of coal, crude oil and natural gas shipped between the Nation's Census Regions. LMI has also provided regional supply functions in these same resources. The volumes and costs are based upon the 1985 Reference Case of the Federal Energy Administration's Project Independence Evaluation System (PIES) Model. Results in terms of volumes and unit costs of fossil fuels moved between Census Regions are shown in matrices.

Coal movements are covered in Chapter I, crude oil in Chapter II, and natural gas in Chapter III. Coal supply curves are presented in Appendix A, oil supply curves in Appendix B, and natural gas supply curves in Appendix C. (MCW)

39691 (NBS-SPEC.PUBL.—434) **Hydrocarbons for fuel: 75 years of materials research at NBS.** Armstrong, G.T. (National Bureau of Standards, Washington, D.C. (USA). Inst. for Materials Research). May 1976. 20p. GPO $0.55.

In this historical review the NBS work on hydrocarbons is discussed in terms of the three major classes of natural hydrocarbonaceous fuels: natural gas, petroleum, and coal. The work done on the measurement of properties of the pure components has included measurement of the values of the properties themselves and development of practical and accurate measurement procedures and instruments. In addition, combustion energies, densities, viscosities, vapor pressures, refractive indices, elemental compositions and other parameters have been determined for complex fuel mixtures and correlated to find methods of estimating properties. Extensive standard reference data tables have been compiled and a number of standard reference materials have been developed. 66 references.

39692 (NTISUB/B—127-76/010) **Monthly energy review.** (Federal Energy Administration, Washington, D.C. (USA)). Oct 1976. 87p. (FEA/B—76/407). Q 05/MF A01.

See also NTISUB/B—127-76/009.

Contains tables, graphs, and data dealing with production, consumption, and prices of crude oil, natural gas, coal, and petroleum products. (GRA)

COAL

REFER ALSO TO CITATION(S) 39070, 39072, 39177, 39659

39693 ERDA asks $2.4B to $6.0B a year for new coal-combustion technologies. *Energy Res. Rep.;* 3: No. 6, 2-4(21 Mar 1977).

ERDA is asking for heavy investment in advanced coal combustion technologies as part of a long-range plan to reduce electricity costs and shift power generation from oil and gas to coal. Annual investments of from $2.4 billion to $6.0 billion are justified on the grounds that, over a 20-year period, electricity costs can be lowered $21 billion to $52 billion. Investments will focus on the following technologies, with estimated dates for commercialization: (1) atmospheric fluidized-bed combustion (1987), (2) pressurized fluid-bed combustion (1993), and (3) open-cycle gas turbines (1990). Programs still needing major design and feasibility studies are: (1) closed-cycle turbines (1990), (2) alkali-metal vapor turbine, envisioned as a topping cycle (1993), (3) molten-carbonate fuel cell (1987), and (4) open-cycle magnetohydrodynamics (1997). Cost and performance data and net conversion efficiencies are projected for each. (DCK)

PETROLEUM

REFER ALSO TO CITATION(S) 39184, 39221, 39570

39694 Corporate planning model for the prediction of exploratory success. Gayden, G.W.; Dalto, S.J. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1976). 8p. (CONF-761008—29).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

A model is developed for use in corporate long-range planning. The model projects future income from and development capital required for discoveries resulting from current and future exploration expenditures. Risk is implicitly considered. It is designed for use by top management and provides a tool by which various exploration strategies can be tested and their sensitivities measured.

39695 Considerations in buying oil and gas production. Zeid, M. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1976). 8p. (CONF-761008—35).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

The purpose of this paper is to emphasize the point that, in order to buy production, industry has to properly evaluate all factors, both technical and psychological and, in fact, be in the "buying mood." If the company has the purpose and a reason, together with the wherewithal to buy, then in order to do so, it has to think positively and look at the plus factors involved and weigh them in their proper perspective with the existing negative factors. Of course, if at the outset it is seen that there are negative factors, then the purchase should not be pursued. However, if the proper plus factors are present and there is a probability of a trade, the main function of engineers engaged in property acquisitions should be to try to make the trade based upon the best technical and economic basis. Obviously, in order to do so, the reasons to make the trade have to be explored extensively. During the past several years the main purchasers of producing oil and gas properties have been from the following categories of companies or individuals: fully integrated major or large independent oil and gas companies; large producing independent oil companies; various trusts, estates, and/or similar institutions; independent oil companies formed for the precise purpose of buying production, with either foreign or domestic capitalization; related company with a need, or desire, to form an oil and gas company; and limited partnership "income funds" either within established companies or newly formed companies. (MCW)

39696 Comparative economics of oil field development projects in several overseas areas. Vadgama, U.N. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1976). 16p. (CONF-761008—25).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Economics of overseas ventures are very dynamic and are a function of the interplay of numerous variable parameters. These differ from corporation to corporation and from country to country. This article attempts to limit the variables in order to obtain specific answers concerning project economics under various overseas contract arrangements. Based on a hypothetical offshore oil field containing half a billion barrels of stock tank oil reserves, and assuming representative development and operating costs, economic analysis is undertaken. Three types of overseas operating terms are considered: conventional OPEC-type, production sharing Pertamina-type, and UK-North Sea type. Sensitivity analysis is presented using variables like oil price, production rates and reserves, royalty and tax rates, development and operating costs, and delay in production startup.

39697 Engineering the oil loan under conditions of economic uncertainty. Miller, R.J. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1976). 11p. (CONF-761008—27).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

This paper examines the impact of current petroleum economics on the valuation procedures used by banks to determine the value of oil and gas properties for production-loan purposes. In the past, determination of collateral value and debt-repayment ability was generally made using rule-of-thumb methods derived from actual lease sales during periods of economic stability. Increasing oil prices, FEA price regulations, and cost inflation have made former rules unreliable for determining current property values. The Rate of Return discount method as a means of relating Fair Market Value determinations to prevailing economic conditions is discussed. A variable discount rate system is developed for determination of the appropriate Rate of Return for discounting. The variable system combines long-term projections of prime lending rate and investment interest rate with historical industry earning trends. The variable system allows the Rate of Return method of valuation to be applied to all properties regardless of economic category or location. The addition to the system of lending and investment rates in foreign countries along with a country risk factor allows the variable rate approach to be used in foreign property valuations. The techniques described are primarily designed to provide the production-loan borrower a means of evaluating the financing potential of his existing properties. Secondary applications include the general determination of the value of properties for sale or acquisition. The paper concludes that traditional rule-of-thumb models based on historical lease sales are unreliable in terms of prevailing economic conditions and both domestic and foreign regulation and tax structures.

NATURAL GAS

REFER ALSO TO CITATION(S) 39694, 39695, 39697

39698 (BNL—22318) **New Jersey's natural gas shortage: a policy analysis.** Cecil, J.L.; Morell, D. (Brookhaven National Lab., Upton, N.Y. (USA)). Dec 1976. Contract EY-76-C-02-0016. 324p. P 15/MF A01.

The public policy problems associated with New Jersey's natural gas shortage are extremely complex and rather difficult to examine. They involve a blend of technology, politics and economics; of regulatory mandates and profit-motivated initiatives; of Federal and state interaction and conflict. To understand the state's gas shortage and to lay the basis for recommending measures to deal with it, information about the basic technology, the organization of the gas industry, the national regulatory posture, and the possible causes of the gas shortage encompasses Part I of the overall study. In Part II, the analysis turns from the national level to a direct examination of New Jersey's gas situation. In Part III, Chapter VIII, the following are considered: the state's supply of natural gas, distribution of these supply volumes within New Jersey by the four major

gas utilities, and gas consumption patterns within the state as a whole and then for each major consuming sector (electric utility, industrial, commercial, and residential). This chapter concludes with an analysis of the impacts of the gas shortage to date in New Jersey, and of its probable effects in the near-term. In the final chapter, some tentative conclusions and broad suggestions are advanced for public policies to mitigate the gravity of the state's position with respect to natural gas. Analysis proceeds, in turn, through consideration of possible state actions in several areas: increasing total interstate gas supplies; increasing New Jersey's share of whatever national total exists; making greater (or more effective) use of alternate fuels; and moderating demand for gas through aggressive conservation policies. Some short-term measures to cope better with whatever level of gas shortage exists in the state at any particular time are suggested. 151 references. (MCW)

39699 (PB—261161) **Highlight report. Volume XX. Public knowledge, attitudes, and behavior relating to natural gas issues.** (Opinion Research Corp., Princeton, N.J. (USA)). Feb 1976. Contract FEA-CO-04-50236-00. 30p. (ORC—25008-Vol-20). Q 03/MF A01.

See also PB—261162.

A nationwide probability sample survey of 1,004 respondents was conducted by ORC by telephone beginning on October 24 through November 9, 1975. Most people believe that a serious need to save natural gas exists in the United States, and they express a willingness to personally make efforts to conserve it. They understand that heating homes consumes a great deal of natural gas, and take steps to conserve home heat. Many consumers do not realize that it takes a great deal of energy to heat water. People do not understand how natural gas supplies are allocated. People believe that natural gas should be conserved in order to save natural resources for the future. Because of this, they would be receptive to reliable, credible information on how to conserve effectively. (GRA)

ELECTRIC POWER

REFER ALSO TO CITATION(S) 39428, 39653, 39682

39700 (CONF-750385—1) **Finding a better way—in the energy crisis.** Hawkins, A. (Central Electricity Generating Board, London (UK)). 1975. 13p. U 01/MF A01.

From Finding a better way in the energy crisis; London, United Kingdom of Great Britain and Northern Ireland (UK) (19 Mar 1975).

The major changes that have occurred and their significance for electrical wholesalers are described. The present situation centers on the price of fuel, not supply. The author reviews the charges for coal and oil in the past few years and estimates future increases. With these increased costs for fuels, charges to customers have risen, and the customer in turn has reduced his consumption. This decrease in demand for electricity has caused the utilities to make a drastic cutback in power station equipment, correspondingly reducing Britain's heavy electrical and boiler plant manufacturing loads. If electricity demand could be evened out, production costs could be reduced. To this end, the Central Electricity Generating Board has restructured the Bulk Supply Tariff under which its customers pay for their bulk supplies. It is hoped the action will reduce consumption of fossil fuels and reduce electricity production costs. Measures taken by the consumer to adjust his electric consumption are discussed briefly. (MCW)

39701 (EPRI-PS—310-SR) **EPRI economic assessment workshop, Chicago, Illinois, September 3—5, 1975.** (Electric Power Research Inst., Palo Alto, Calif. (USA)). Nov 1976. 48p. P 03/MF A01.

The results of the Economic Assessment Workshop held in Chicago in September 1975 are reported. Participants from the electric utility industry and from the Electric Power Research Institute staff discussed utility methods of economic assessment, system analysis, and application criteria as related to the selection of new technologies for use by the industry. Guidance was provided for establishing EPRI's methods and criteria for technology assessment, economic evaluation, and cost/benefit analysis so that research priorities at EPRI will result in maximum value to the utility industry. The participants in the workshop were divided into three groups and a report on the detailed discussions of each group is included. The general subject areas were evaluation criteria for R and D alternatives, application of economic assessment to R and D planning, and application of system analysis techniques to R and D planning. Each of these subjects was considered in detail and recommendations for appropriate EPRI approaches are reported.

39702 (EPRI-PS—357-SR) **EPRI technical assessment workshop, Chicago, Illinois, September 28—29, 1976.** (Electric Power Research Inst., Palo Alto, Calif. (USA)). Jan 1977. 27p. P 03/MF A01.

Participants from the electric utility industry and from the Electric Power Research Institute staff discussed the analytic processes used by utilities when considering the introduction of new technologies on a power system. The workshop resulted in a better understanding by the participants of how EPRI might improve its methods and criteria for assessing the value of new technologies to the utility industry so that research priorities at EPRI can be set for the greatest benefit. The participants in the workshop were divided into three groups for detailed discussion, and a report on the deliberations of each group is included. The general subjects of the three groups were: R and D program evaluation procedures; economic assessment methods; and system analysis techniques. Each of these subjects was covered in detail and recommendations for appropriate EPRI approaches are included. This workshop is part of a continuing effort to maintain a dialog between the EPRI staff and the utility industry concerning the methods being used to analyze research priorities.

39703 (NP—21780) **Rate design and load management: a progress report to the National Association of Regulatory Utility Commissioners.** (Electric Power Research Inst., Palo Alto, Calif. (USA)). 28 Oct 1976. 60p. TIC.

This report describes the research conducted to date by EPRI and EEI on behalf of the regulatory community and in response to NARUC Resolution No. 9. The resolution which focuses on rate design in particular and load management in general, calls for a study of the technology and cost of time-of-day pricing as a means of controlling peak-load growth. The Plan of Study divides the research into costing and rate design; meters, user equipment, and controls; customer response; and cost benefit analyses of load shifting. Three pricing topics are grouped in the first study area: peak-load pricing; costing for peak load pricing; and rate design. Three engineering topics are grouped in the second study area; metering; equipment for using off-peak energy; and load controls and penalty pricing. The third study area, customer response, includes elasticity of demand; rate design and load management experiments; and customer acceptance of load management. The fourth study area is the development of cost-benefit methodologies to assess load shifting. Many crucial reports from the task forces and the consultants are still in preparation; therefore, no conclusions are set forth in this progress report. The conclusions will be presented in a final report. (MCW)

39704 (TID—27475) **Advanced concepts for bulk power system studies.** Masud, E. (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Electric Energy Systems). 1976. 7p. P 02/MF A01.

Over the years the gap between the science available for system planning and the application of this science to real world problems has steadily widened. At the same time the demand for timely studies of regional and national scope of the bulk power system has increased dramatically. This paper presents a unified approach that will reduce the gap between the science and application and will provide a facility for timely studies. Also, it will serve as a focal point and foundation for research and development in system planning methodology. It will achieve this by utilizing the most advanced concepts in computation and pictorial presentation to create a bulk power system study capability unmatched in the United States, and perhaps the World. 41 references.

39705 **Dynamics of electric utility rate regulation.** Secrest, L.; Burzlaff, B. (Texas Christian Univ. Research Foundation, Fort Worth). pp 594-600 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

A nationally aggregated DYNAMO model was developed for simulating the financial dynamics of the U.S. electric utility industry. The regulatory sector of this model is presented in detail with flow diagrams and causal loop structures. After examining the regulatory sector, it is concluded that electric utility prices should be regulated on the basis of being a dynamic variable when financial conditions are changing, and that the proposed dynamic pricing approach could improve the performance of regulatory procedures as measured against the goals of achieving maximum performance and the most efficient allocation of scarce resources. (LCL)

39706 **Electricity demand analysis and forecasts for the United States.** Chern, W.S.; Gill, G.S.; Carlsmith, R.S.; Cohn, S.M. (Oak Ridge National Lab., TN). pp 770-773 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

Significant social costs are associated with both underestimation and overestimation of electricity demand growth. Utility capac-

ity based on the former will lead to frequent brownouts and blackouts, while that based on the latter will avoidably lock up productive resources and also aggravate the already serious utility financing problems. In both cases, national output will be reduced due to inefficient resource allocation. Accordingly, reliable forecasts of electricity demand are imperative. Forecasts of electric power demands are presented using an econometric model for electricity use in the residential, commercial, and industrial sectors. The principal merit of this approach is that it relates future electricity demand to changes in individual causal factors, whereas the trend method merely replicates the past. Thus the detailed knowledge of demand structure embedded in the econometric model provides an analytical framework for forecasting demand in a period of abrupt changes in the causal factors. If future prices of electricity and other substitutes fall into the assumed range and if future levels of income, population and other independent variables are consistent with the assumptions, the econometric model predicts that total electricity demand in the U.S. will increase 3.8 percent to 4.1 percent per year during 1973 to 1985.

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 39449, 39450, 39452, 39453, 40241

39707 (NP—21735) **Future power stations: what will they be like.** Leason, D.B. (Central Electricity Generating Board, London (UK)). 1976. 16p. U 01/MF A01.

No dramatic switch is envisaged in the evolution of power stations. The trend to augment the substantial fossil fuel stations with nuclear plant will continue and this will ease the challenge of power station appearance. This challenge has been accepted and successfully met over many decades. Older stations will gradually disappear, especially in urban areas, to be replaced on some sites by compact, powerful but quiet gas turbine stations, sometimes associated with direct heating. Adherence, in general, to progressive developments of proven plant will enable station output capacity to be increased with less than a proportionate increase in station bulk and land requirement. The rate at which older stations disappear will depend on the country's prosperity and hence both the change in electricity requirements and the proportion of resources which can be devoted to new power stations.

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

39708 (CONS/2050—1(Vol.3)) **Analysis and forecast of electrical distribution system materials. Final report. Volume III. Appendix.** Love, C.G. (Westinghouse Research Labs., Pittsburgh, Pa. (USA)). 23 Aug 1976. Contract E(49-18)-2050. 311p. P 14/MF A01.

These appendixes are referenced in Volume II of this report. They contain the detailed electrical distribution equipment requirements and input material requirements forecasts. Forecasts are given for three electric energy usage scenarios. Also included are data on worldwide reserves and demand for 30 raw materials required for the manufacture of electrical distribution equipment.

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 39652, 39655, 39670, 39672, 39675, 39708, 39721, 39722

39709 (ORNL/CON—8) **Improved engineering-economic model of residential energy use.** Hirst, E.; Cope, J.; Cohn, S.; Lin, W.; Hoskins, R. (Oak Ridge National Lab., Tenn. (USA)). Apr 1977. Contract W-7405-ENG-26. 68p. P 04/MF A01.

An improved version of the ORNL residential energy use model was developed to simulate energy use in the residential sector from 1970 through 2000. The model provides considerable detail on annual energy uses by fuel, end use, and housing type; and also estimates annual equipment installations and ownership, equipment energy requirements, structural thermal integrities, fuel expenditures, equipment costs, and costs for improving thermal integrities on new and existing housing units. Thus, the model provides considerable detail on residential energy uses and associated costs. These details are useful for evaluating alternative energy conservation policies, programs, and technologies for their energy and economic effects during the next quarter century. The present version of the model deals with four fuels, eight end uses, and three housing types. Each of these 96 fuel use components is calculated each year as a function of stocks of occupied housing units and new construction, equipment ownership by fuel and end use, thermal integrity of housing units, average unit energy requirements for each equipment type, and usage factors that reflect household behavior. Simulations of energy use from 1960 to 1975 show that the model accurately predicts historical data on aggregate energy use, energy use by fuel, energy use by end use, and equipment ownership market-shares. A reference projection developed with the model shows residential energy use growing from 17.5 GGJ (10^{18} joules) in 1975 to 18.5 GGJ in 1980 and 26.6 GGJ in 2000, with an average annual growth rate of 1.7 percent. Electricity increases its share of the energy budget from 44 percent in 1975 to 67 percent in 2000. Shares provided by gas, oil, and other fuels all decline during this period.

39710 (PB—261365) **Energy usage characteristics of single family residences and their occupants in Illinois. Volume 2. Results.** (Nielsen (A.C.) Co., Northbrook, Ill. (USA). Retail Index Div.). Aug 1976. 265p. Q 12/MF A01.

Sponsored in part by Illinois State Dept. of Business and Economic Development, Springfield. Div. of Energy. See also Volume 1, PB—259519.

This report presents data obtained from measuring the existing thermal performance (current condition) characteristics of the selected residential dwelling units in Illinois, including such factors as the amount of insulation in the ceiling, sidewalls and foundation; and, obtaining relevant socio-economic characteristics of the residents of the sample households in Illinois. (GRA)

39711 (UCID—17443) **U.S. energy flow in 1976.** Ramsey, W.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Mar 1977. Contract W-7405-ENG-48. 8p. P 02/MF A01.

An energy flow diagram for the U.S. for 1976 is presented, and one for 1975 is included for comparison. Some significant differences between 1975 and 1976 are: total energy use increased 4.8 percent, almost reaching the record use of 1973; oil imports increased significantly to 15.5 quads, more than 20 percent above 1975, and almost 44 percent of our total oil use; coal and natural gas remained more or less constant; by the author's reckoning, the industrial sector was unique in that its energy use decreased somewhat due to conservation efforts; delivered nuclear power increased by 10.9 percent and a trend toward electrification continued with distributed electrical energy increasing by 6.1 percent. (MCW)

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 39681

39712 (BNL—22311) **Role of renewable energy technologies in developing countries.** Palmedo, P.F. (Brookhaven National Lab., Upton, N.Y. (USA)). 10 Jan 1977. Contract EY-76-C-02-0016. 11p. P 02/MF A01.

Some of the implications of the choice between renewable, decentralized technologies and nonrenewable, centralized technologies as applied to developing countries are presented. The focus on developing countries does not imply that the choice is not a pertinent one for developed countries, but only that it is a particularly pressing one for the lesser-developed countries. In order to clarify the significance of the distinction between renewable and depletable resources, two qualifications are made. The resource and its feasible system to use that resource is of primary interest. Sunlight is free but the devices to use that resource may require a rare metal, which then makes the use of solar energy not renewable. The second qualification is that some resources that are finite such as deuterium as used in fusion reactors have such large abundance that they can be considered renewable. Some specific steps that can be taken to give renewable energy resources an opportunity to compete on a more equal footing with conventional fossil and nuclear technologies in the LDCs are: stimulate and support energy planning in developing countries; include appropriate technology in developed country R and D programs; and develop and demonstrate technologies in the LDCs. These activities would represent no financial burden to the developed world. A realistic appraisal of potential renewable resources to meet the future enegy needs of developing countries is important. (MCW)

OTHER

REFER ALSO TO CITATION(S) 39382

39713 **Solid waste: materials and energy recovery. Twenty-fifth report by the Committee on Government Operations. House of Representatives, Ninety-Fourth Congress, Second Session, Report No. 94-1319.** Washington, DC; Committee on Government Operations (1976). 28p. GPO.

The report submitted by the Conservation, Energy, and National Resources subcommittee to the Committee of the Whole House examines the problem of municipal solid-waste disposal and finds that it is an urgent one that few communities have solved satisfactorily. Federal programs in this area have been inadequate. The technology for materials and energy recovery is well developed and economically sound, but its development is hampered by legal, political, financial, and institutional problems. The state programs of Wisconsin and Connecticut are successfully overcoming these obsta-

cles. Federally financed research and development programs in solid-waste management should be merged, but no Federal assistance is needed for construction of local resource recovery facilities. (JSR)

39714 Policy for tidal energy. Shaw, T.L. (Univ. of Bristol, Eng.). *Mar. Policy;* 1: No. 1, 61-69(Jan 1977).

The potential of tidal energy for the United Kingdom should be reassessed, it is argued, and some of its advantages are cited. The technology for its development is available and proven; experience suggests that the capital works will have an indefinite life, with only the turbine blades needing to be replaced occasionally. It is a source of water power, and can be regulated to generate when required, on a flexible basis and only by day if so desired; this compares favorably with the relatively unpredictable nature of the other sources. It can be made to complement directly, and so to improve the performance of the coal and nuclear sources at a scale readily possible from a proportionately small installed capacity. The fuel is free. Present indications unquestionably suggest that it will be timely to reassess this source as part of the present energy review, so that its potential may be realized when needed after 1990. It is especially significant that the environmental effects of the necessary works appear to be comparatively small whereas the industrial and social rewards, so far not financially quantified, could be appreciable. The disadvantages that have been expressed are cited, but the author counters the attack on them. (MCW)

ENERGY CONVERSION

REFER ALSO TO CITATION(S) 39366

39715 Power supply. Hart, E.J.; Leeman, J.E.; MacDougall, H.R.; Marron, J.J.; Smith, C.C. (to Energy Research and Development Administration). US Patent 3,985,078. 12 Oct 1976. Filed date 11 Sep 1975. 16p.

PAT-APPL-612,394.

An electric power supply employs a striking means to initiate ferroelectric elements which provide electrical energy output which subsequently initiates an explosive charge which initiates a second ferroelectric current generator to deliver current to the coil of a magnetic field current generator, creating a magnetic field around the coil. Continued detonation effects compression of the magnetic field and subsequent generation and delivery of a large output current to appropriate output loads. 11 claims, 10 figures.

MHD GENERATORS

DESIGN AND DEVELOPMENT

39716 (ERDA-tr—264) Excerpts from the 1975 annual report of the USSR Institute of High Temperatures, Moscow. 1975. Translation of USSR Papers. 78p. Dep. NTIS $5.00.

This report was prepared by the USSR Institute of High Temperatures and was translated by the ERDA-FE MHD Division as part of the US-USSR Cooperative Program in MHD Power Generation. Three chapters were translated: Investigations of high temperature processes, mass transfer and physical gas-dynamics; Development and investigatins of new refractory materials; and Investigations of the facilities for direct heat conversions into electrical power by means of MHD generators. Also an extensive bibliography of presented papers, publications, and patents by members of the Institute of High Temperatures during 1975 is presented. (WHK)

39717 Dynamic analysis of a liquid metal MHD loop. Saphier, D. (Argonne National Lab., IL). pp 183-186 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

An experimental closed cycle liquid metal MHD generator has been proposed at Argonne National Laboratory to test the technical feasibility and effectiveness of producing electricity by means of heated two-phase sodium argon flow mixture. In the present study a dynamic analysis of the proposed MHD loop was performed to determine system stability. A detailed component analysis was carried out and a mathematical model for each component of the system was developed. The mathematical models were formulated using the basic principles of mass, energy and momentum conservation, the ideal gas laws, and sodium thermodynamic data. In the section where two-phase flow prevails, two-phase friction factor correlations were used. A digital computer simulation program was developed using the IBM Continuous System Modeling Program (CSMP); each component model was comprised of one or more discrete nodes. Using the approach of nodal discretization is well justified in this type of study where general dynamic performance and system stability are to be assessed.

FUEL CELLS

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 39382, 39623

39718 (EPRI-EM—384) Application of the Alsthom/Exxon alkaline fuel cell system to utility power generation. Final report. Elzinga, E.R.; Bannochie, J.G.; Bellows, R.J.; Correa, J.H.; Horowitz, H.H.; Snyder, C.W. (Exxon Enterprises, Inc., New York (USA)). Jan 1977. 247p. P 11/MF A01.

Exxon Enterprises, Inc., at the request of EPRI, has completed an evaluation of Alsthom/Exxon alkaline fuel cell technology for application to utility power generation. The purpose of this study was to determine how close the technology could come to EPRI efficiency, investment, and related targets and to begin to define those limitations which must still be overcome. The program consisted primarily of a systems analysis to explore the effect of major variables such as fuel cell operating temperature, fuel type and degree of carbon oxides preremoval on efficiency and cost. Most of the effort centered around minimizing cost and heat rate by selecting the most appropriate process techniques and by heat integrating the various parts of the process. Two routes were found for meeting the EPRI heat rate targets, 7100 Btu/kWh with methanol and 7500 Btu/kWh with naphtha as starting fuel. The simplest route involved reforming followed by Pressure Swing Absorption yielding a nearly pure hydrogen feed to the fuel cell. Alternatively, carbonate scrubbing could be used but required an increased fuel cell temperature of 393°K so that waste heat could be used for carbonate regeneration. The major uncertainty was in the assumed fuel cell performance which while taken from the literature for alkaline fuel cells has not yet been achieved with Alsthom/Exxon components. Investments for a 400 MW plant were between 20 and 30 percent higher than the target of $200/kW in 1974 dollars. Since the estimates contain no allowance for contingencies it would be unrealistic to project lower costs.

39719 Fuel cell structure and system, more particularly for a carbon fuel and atmospheric air. Warszawski, B. (to Societe Generale de Constructions Electriques et Mecaniques "Alsthom et Cie"). US Patent 4,002,493. 11 Jan 1977. Priority date 25 Jan 1974, France. 14p.

This structure is constituted by several cells each comprising, more particularly, an anode and a cathode separated by a corrugated membrane partly immersed in the electrolyte, as well as a condensor-exchanger device for the water drawn off by the combustive, that water being made to flow back towards the electrolyte by means of a plane part of the membrane coming and bearing against one of the walls of the condensor-exchanger. 24 claims, 21 figures.

APPLICATIONS

REFER ALSO TO CITATION(S) 39784

ELECTROCHEMISTRY, MASS TRANSFER, AND THERMODYNAMICS

39720 Influence of bonding and filling agents on the activity of tungsten carbide hydrogen electrodes. Svata, M. (Inst. of Physical Chemistry and Electrochemistry, Prague); Rudolf, S. *J. Power Sources;* 1: No. 3, 277-284(Apr 1977).

The structure of polytetrafluoroethylene and polyethylene bonded tungsten carbide electrodes was varied by changing the ratio of the bonding agent to the catalyst, and by adding various amounts of fillers of a different type. Of the series of fillers used, good results were obtained with oxalic acid, ammonium chloride and ammonium nitrate. The effect of the filler was ascribed to its influence on the surface properties of the pore wall rather than to the rise in the porosity of the electrode.

POWER CYCLES

REFER ALSO TO CITATION(S) 39432

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 39650, 39652, 39671, 39679, 39681, 39706, 39711

BUILDINGS

REFER ALSO TO CITATION(S) 39611, 39613, 39672, 39674

39721 (ERDA—76/163/1) **Building energy handbook. Volume I. Methodology for energy survey and appraisal.** (Energy Research and Development Administration, Washington, D.C. (USA)). Dec 1976. Contract EX-76-C-10-3853. vp. P 15/MF A01.

The United States Energy Research and Development Administration (ERDA) ENERGY HANDBOOKS present guidelines to investigate and analyze energy usage, to identify energy-saving opportunities, and to recommend and evaluate energy conservation measures at ERDA facilities. The methodology was developed and tested while conducting an actual energy conservation survey at a major ERDA installation: Argonne National Laboratory, ANL-East, at Argonne, Illinois. It is anticipated that the methodology will be further developed, and the HANDBOOKS appropriately revised, as additional ERDA facilities are surveyed. It is hoped that the HANDBOOKS' methodology will also prove useful for conducting energy conservation surveys of facilities of other Federal, state, and local agencies and of the private sector. The survey methodology is presented in two parts. The SITE ENERGY HANDBOOK, published as ERDA-76/131/1 and ERDA-76/131/2, covers site energy and utility distribution systems, and the BUILDING ENERGY HANDBOOK pertains to the interior systems. The interface is essentially the traditional "five feet outside the building line," assuming due allowance for meter location, system interaction, etc. Volume 1 of the BUILDING ENERGY HANDBOOK contains the following 5 chapters: Executive Summary; Selection of Buildings for Detailed Energy Study; Building Energy Appraisal; Survey and Appraisal of Building Energy Conservation Opportunities; and Energy Conservation Opportunities.

39722 (ERDA—76/163/2) **Building energy handbook. Volume II. Forms for energy survey and appraisal.** (Energy Research and Development Administration, Washington, D.C. (USA)). Dec 1976. Contract EX-76-C-10-3853. vp. P 09/MF A01.

Volume 2 of the BUILDING ENERGY HANDBOOK contains the building energy survey and appraisal forms for use in conjunction with the methodology of Volume 1, within the following categories: forms for Selection of Buildings for Detailed Energy Studies presented in Chapter 2; forms for Building Energy Survey and Appraisal presented in Chapter 3; and forms for Building Energy Conservation Opportunity (ECO) Survey and Appraisal presented in Chapter 4.

39723 (NBS-BSS—69) **NBSLD, the computer program for heating and cooling loads in buildings.** Kusuda, T. (National Bureau of Standards, Washington, D.C. (USA). Inst. for Applied Technology). Jul 1976. 398p. GPO $4.60.

A comprehensive computer program called NBSLD, the National Bureau of Standards Load Determination program, has been developed at NBS to reflect the time change of the many building parameters which are pertinent to accurate estimation of energy usage for heating and cooling. Current status of heating and cooling load techniques is reviewed. Of general interest are unique features of NBSLD which are not available in existing computer programs. A summary of various subroutines of NBSLD is given along with the detailed procedures for them. These subroutines constitute the recommended subroutine algorithms of the ASHRAE Task Group on Energy Requirements. Complete Fortran listing of NBSLD and data preparation forms are given for those who wish to use the program. The NBSLD computation is on the basis of the detailed solution of simultaneous heat balance equations at all the interior surfaces of a room or space. Transient heat conduction through exterior walls and the interior structures is handled by using conduction transfer functions. The use of heat balance equations, although time consuming in calculation, can avoid the vagueness and uncertainties inherent in the more popularly used weighting factor approach. In addition, it is more accurate for a specific build-design.

39724 (PB—259761) **Energy conservation in buildings: a human factors/systems viewpoint. Building science series.** Rubin, A.I. (National Bureau of Standards, Washington, D.C. (USA). Center for Building Technology). Nov 1976. 22p. (NBS-BSS—88). Q 02/MF A01.

Library of Congress catalog card No. 76-600058.

Suggestions put forward to conserve energy in buildings are briefly discussed, along with the question of whether environmental quality must be degraded if energy conservation in buildings is to be achieved. (GRA)

39725 (PB—259998) **Value incentive program energy conservation compressors for computer room air conditioning systems. Final report.** (Kempter-Rossman International, Washington, D.C. (USA)). Oct 1976. 39p. Q 03/MF A01.

A case study on the use of the Value Incentive Clause by a GSA/FSS contractor to make product improvement suggestions on energy conservation compressors for computer room air conditioning systems is presented. The use of this clause allows for contractors who hold FSS contracts to make suggestions to reduce the overall cost of procurement to the government and to share in the savings resulting from their suggestion. Copies of the GSA order, and the clause itself are included in addition to the specific changes proposed for the energy conservation compressors for computer room air conditioning systems.

39726 (NP-tr—1964) **Heat pipes as a method of heat recovery.** Bader, E.E. Translated by A. Macdonald from *Schweiz. Bauztg.;* **93**: No. 10, 123-125(6 Mar 1975). 7p. U 02/MF A01.

As an inexpensive installation for heat recovery in air conditioning systems and factories, heat pipes fill a gap in the field of energy-saving measures. Their method of operation, which consists of a simple way of making it possible to transfer heat from a hot medium to a colder one, with a minimum space requirement, is described and illustrated with examples.

39727 **Exemplary cycles of district heating plants.** Andryushchenko, A.I. (Saratov Polytech Inst, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 8, 80-84(Aug 1976). (In Russian).

It is shown that the highest fuel savings in district heating plants can be obtained by realizing the recommended exemplary cycles differing from the Carnot cycle by a lower compression work. With the same thermal efficiency, this leads to a considerable increase in absolute internal efficiency of the real cycle. The higher efficiency of the steam cycles is explained.

39728 **Effect of the scheme of connection of an evaporating plant to a system of regeneration of district heating turbines on the cost of the distillate.** Stepman, L.S.; Shchepetil'nikov, M.I.; Moshkarin, A.V. (Moscow Power Eng Inst, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 9, 53-59(Sep 1976). (In Russian).

A method of comparison of thermal efficiency of the diagram of connection of evaporators for district heating turbines is worked out. Diagrams of connection of makeup water heating, with makeup water treatment by the chemical and thermal methods, as applied to the T-100-130 turbine, are compared.

39729 **Stirling cycle heat pump.** Raetz, K. US Patent 4,010,621. 8 Mar 1977. Priority date 4 Jan 1974, German, Federal Republic of (F.R. Germany). 6p.

A heat pump which is based on the principle of the Stirling engine and in which the pistons are replaced by flexible metal bellows is described. The pumping chamber is embraced by a regenerator of corrugated metal ribbon construction and enclosed in a pressure-tight vessel.

39730 **Damper for heating/cooling system.** Harbin, F.; Slater, H.W. (to Laer Siegler, Inc.). US Patent 4,011,903. 15 Mar 1977. Filed date 24 Mar 1975. 4p.

A sliding damper plate is positioned between the blower and heat exchanger of a down draft gun-type furnace for mobile home usage and includes cam means at opposite ends thereof for actuating associated switches coupled to the furnace and air conditioning control circuits. When the damper is closed to cut off the flow path through the furnace to permit a separate air conditioner unit to utilize the existing heating ductwork in a mobile home, one of the switches is actuated to permit operation of the air conditioning unit. Alternatively, when the damper is moved to an open position for heating operation, the air conditioning unit is inactivated and a second switch closed by the cam to permit furnace operation. If the damper is partially open or closed, both the furnace and air conditioning unit are deactivated.

RESIDENTIAL

REFER ALSO TO CITATION(S) 39609, 39669, 39676, 39677, 39678, 39699, 39709

39731 **Thermal insulation provided by triangular sectioned attic spaces.** Probert, S.D.; Thirst, T.J. (Cranfield Inst. of Tech., Bedford, Eng.). *Appl. Energy;* **3**: No. 1, 41-50(Jan 1977).

The pitch of a triangular roof, apex upwards, should be about 15° in order to achieve a relatively high ratio of thermal insulation (in the absence of wind penetration) to capital investment. The thermal insulation provided by the contained air may be enhanced by incorporating a light, inverted T structure (suspended from the roof apex) because this inhibits the convective currents, as well as providing some radiation shielding.

OFFICE

39732 (NBS-BSS—78) **Pre-design analysis of energy conservation options for a multi-story demonstration office building.** Kusuda, T.; Hill, J.E.; Liu, S.T.; Barnett, J.P.; Bean, J.W. (National Bureau of Standards, Washington, D.C. (USA). Inst. for Applied Technology). Nov 1975. 64p. GPO $1.25.

The design phase of the GSA-Manchester Building included extensive analysis of the building design and operation to determine the potential for energy conservation. Described are highlights and a summary of the calculations performed during the design phase. The analysis included a study of the effect of the exterior shell, ventilation rate, lighting and occupancy levels, room temperature controls, and nighttime flushing of the building using outdoor air on the predicted yearly energy consumption of the building.

SCHOOL

REFER ALSO TO CITATION(S) 39669

COMMERCIAL

REFER ALSO TO CITATION(S) 39670

TRANSPORTATION AND PROPULSION

REFER ALSO TO CITATION(S) 39672, 39690

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 39675, 39763, 39774, 39775

INDUSTRY

REFER ALSO TO CITATION(S) 39660, 39672, 39721, 39722

39733 (NP—21746) **Energy use and conservation in the poultry and egg industry. Agricultural economic report No. 354.** Rogers, G.B.; Benson, V.W.; Van Dyne, D.L. (Department of Agriculture, Washington, D.C. (USA)). Oct 1976. 55p. Dept. of Agricultural, Economic Research Service, Washington, DC.

Estimates of energy use in the poultry and egg industry are discussed by commodity, type of fuel, season, and function. In 1974, the 146.5 trillion Btu's used in poultry production and marketing cost producers almost $550 million. Although the efficiency of energy use in this industry has increased in the last decade, energy conservation measures discussed in this report can yield further substantial savings. Development and implementation of new technologies may reduce the use of critical forms of energy in the future. This study is intended to provide a basis for further energy research in the poultry and egg industry and to serve as a prototype for similar energy studies on other agricultural industries.

39734 **Energy for steel production: prospects and options.** Elliott, J.F. (Massachusetts Inst. of Tech., Cambridge). pp 1-17 of In Energy use and conservation in the metals industry. Chang, Y.A. (ed.). New York; Metallurgical Society of AIME (1975).

From Annual meeting of the Society of Mining Engineers of AIME; New York, New York, USA (16 Feb 1975).

See CONF-750204—P2.

The steel industry is energy intensive and the apparent total consumption of energy by the U.S. industry was 3.55 and 3.91 x 10^{15} Btu in 1972 and 1973, respectively. The apparent average consumption per ton of raw steel produced is 26 x 10^{6} Btu. It is anticipated that the consumption of energy by the industry will not grow as fast as the production of steel in the future because of the anticipated increased fractional use of the electric furnace and improved yield of finished steel from raw steel as a result of increased use of strand casting. More economical use of energy and fuels will also reduce the growth in consumption of energy by the industry.

39735 **Fuel and energy conservation in the steel industry.** Sigworth, G.K. (Inland Steel Research Labs., East Chicago, IN). pp 19-40 of In Energy use and conservation in the metals industry. Chang, Y.A. (ed.). New York; Metallurgical Society of AIME (1975).

From Annual meeting of the Society of Mining Engineers of AIME; New York, New York, USA (16 Feb 1975).

See CONF-750204—P2.

The current use of the term "energy conservation" has obscured, to a certain extent, the problem facing the steel industry, i.e., energy is not readily available in its desired forms. Some fuels are relatively plentiful while others are scarce. The challenge before the steel industry is then twofold: total energy conservation and conservation of scarce fuels. Some opportunities for both types of conservation are outlined, and recommendations are made for areas of future concentration.

39736 **Energy requirements for various steelmaking processes.** Barnhart, T.F. (Steel Research Lab., Monroeville, PA). pp 41-51 of In Energy use and conservation in the metals industry. Chang, Y.A. (ed.). New York; Metallurgical Society of AIME (1975).

From Annual meeting of the Society of Mining Engineers of AIME; New York, New York, USA (16 Feb 1975).

See CONF-750204—P2.

The energy requirements for various steelmaking processes and the responses of the steel industry to changes in the cost and availability of energy are outlined. The steelmaking processes examined include: scrap-electric furnace-continuous casting; integrated modern blast furnace-basic oxygen continuous casting; and direct reduction-electric furnace-continuous casting. As a result of the changes in the energy situation, several changes in steelmaking in the future are forecast and include: steelmaking capacity will likely be installed in foreign countries that have an ample supply of inexpensive natural gas; prereduced agglomerates will likely be produced in areas where inexpensive natural gas is available together with a source of iron ore and shipped as a world commodity, since this will be the cheapest system for transporting natural-gas energy to countries where this form of energy is scarce or expensive; and nuclear steelmaking techniques will be pursued in the United States and abroad to make a new energy source available to the steel industry. In conclusion, it appears that we are headed into a period of rapid change in the steel industry. Traditionally, these changes have been brought about by economic considerations of production and markets. Processes of the future will have an added constraint in the form of energy they consume and this may prove to be the overriding factor in the choice of technology used for future steelmaking.

39737 **Energy use and conservation in aluminum production.** Sheldon, A.C. (Aluminum Co. of America, Pittsburgh). pp 157-171 of In Energy use and conservation in the metals industry. Chang, Y.A. (ed.). New York; Metallurgical Society of AIME (1975).

From Annual meeting of the Society of Mining Engineers of AIME; New York, New York, USA (16 Feb 1975).

See CONF-750204—P2.

During the past three decades, the electrical energy needed to produce a pound of fabricated aluminum from the ore has been cut nearly in half. This reduction was achieved in the smelting area, where electric power consumption was cut from an average of 12 to 8 kWh per pound of metal produced, and to 6.5 kWh in today's most efficient smelters. That consumption will decrease another 30 percent to 4.5 KWh, with the Alcoa Smelting Process. Alcoa's commitment to strong energy management is manifest in three major areas: research and development, improvements to production practices and procedures, and energy conservation. Ongoing efforts in all three areas have contributed to the reduction in energy use and will continue to make significant contributions. Future reductions in energy use by Alcoa are projected to be a decline from 1972 levels of 10 percent by 1980 and of a total 30 percent by the year 2000. These reductions will be accomplished by intensified energy conservation programs. Energy management will be emphasized. The Alcoa Smelting Process will be installed in future domestic plants. Rotary kilns used in refining will be replaced by flash calciners. Heat recovery will be practiced wherever practical and possible. And present levels of recycled aluminum will be increased 45 percent between 1975 and 1980, largely through the higher rate of return of aluminum beverage cans by consumers, increased recovery of aluminum from the solid waste stream by municipalities, and increased return of scrap from all mill product customers.

39738 **Energy management systems metal industry perspective.** Elbling, P. (IBM Corp., Chicago). pp 249-258 of In Energy use and conservation in the metals industry. Chang, Y.A. (ed.). New York; Metallurgical Society of AIME (1975).

From Annual meeting of the Society of Mining Engineers of AIME; New York, New York, USA (16 Feb 1975).

See CONF-750204—P2.

Energy management systems in the U.S. metal industry are discussed. Some current and possible future activities in this area are examined. Current estimates of the gross energy needs and requirements of the industry are highlighted as background information. A discussion of power management concepts emphasizing the electric power demand application is provided. This is followed by a presentation of the energy management application as it is currently implemented. An examination is made of the latest trends in the energy management area. These indicate that metal companies are committing resources to model energy systems, i.e., the development of simulation models to optimize energy allocation.

39739 **Energy requirements for iron and steelmaking.** Larwood, G.M.; Leary, R.J. (Bureau of Mines, Pittsburgh). pp 259-270 of In Energy use and conservation in the metals industry. Chang, Y.A. (ed.). New York; Metallurgical Society of AIME (1975).

From Annual meeting of the Society of Mining Engineers of AIME; New York, New York, USA (16 Feb 1975).

See CONF-750204—P2.

Energy needs for contemporary iron and steel making are examined. Recent trends in fuel consumption are analyzed to sort out the effects of technologic changes, improvements within a process and the substitution of processes. Contemporary average and best practice for iron smelting are compared to measure the possibilities of further change in the average usage by implementing completely the best contemporary practice. For the future, it appears that the U.S. steel industry will: strengthen its coal dependency with some combination of by-product and formcoking; move quickly to energy-saving methods following the present lead of Japan and Western Europe as the availability of energy tightens and prices spiral, (this will amplify the already tight supply of capital); and will not move significantly towards direct reduction because of high gangue content of domestic ore, the additional net energy requirements, and general dependency of many direct reduction processes on natural gas.

39740 Energy considerations in copper, lead, and zinc smelting. Parameswaran, K.; Nadkarni, R. (Arthur D. Little, Inc., Cambridge, MA). pp 271-298 of In Energy use and conservation in the metals industry. Chang, Y.A. (ed.). New York; Metallurgical Society of AIME (1975).

From Annual meeting of the Society of Mining Engineers of AIME; New York, New York, USA (16 Feb 1975).

See CONF-750204—P2.

Selected problems associated with better energy utilization in copper, lead and zinc recovery from concentrates are discussed along with illustrative examples.

39741 Environmental management in the steel industry: a survey. Ito, K. (Osaka Univ.). *Int. J. Environ. Stud.;* 9: No. 4, 257-267(1976).

This survey deals with many environmental management problems in the iron and steel industry and it is mainly based on Japanese data. First, the characteristic features of pollution problems in the iron and steel industry are clarified by comparing them with those of other industries. Second, a detailed classification is made of environmental pollution phenomena in the iron and steel industry, and a model plant adopting modern pollution control devices is introduced. Finally, taking a recycling system as an example, the necessity to establish total environmental management systems is emphasized.

ENERGY SOURCES

39742 Energystics of metal production. Agarwal, J.C.; Sinek, J.R. (Ledgemont Lab., Lexington, MA). pp 121-129 of In Energy use and conservation in the metals industry. Chang, Y.A. (ed.). New York; Metallurgical Society of AIME (1975).

From Annual meeting of the Society of Mining Engineers of AIME; New York, New York, USA (16 Feb 1975).

See CONF-750204—P2.

The energy crisis, its causes, and the reasons why high energy costs and low availability are likely to be unavoidable are described and related to the primary metal industry. Energy profiles for the production of several base metals are established. A discussion on the interchangeability of energy forms indicated that it is not always possible. Where possible, cost considerations of the total energy system investment are advised as aids to energy planning, in lieu of extrapolation of past fuel costs. Once an energy form has been decided, an adequate trade-off between capital and energy cost must be pinpointed.

MATERIALS

REFER ALSO TO CITATION(S) 39708

EQUIPMENT AND PROCESSES

39743 (PB—259629) **Applications of thermography for energy conservation in industry. Technical note.** Hurley, C.W.; Kreider, K.G. (National Bureau of Standards, Washington, D.C. (USA). Center for Building Technology). Oct 1976. 34p. (NBS-TN—923). Q 03/MF A01.

Infrared thermography has been developed as a tool to measure the temperature of various types of surfaces. To assist energy conservation engineers to assess heat losses in industrial plants, a survey was conducted of furnaces and heating systems in addition to electrical and mechanical systems. This qualitative survey has been found to be an excellent method to detect heat losses in unit process equipment and auxiliary systems.

39744 Melting cathode copper: a case study in process energy efficiency. Kellogg, H.H. (Columbia Univ., New York). pp 87-99 of In Energy use and conservation in the metals industry. Chang, Y.A. (ed.). New York; Metallurgical Society of AIME (1975).

From Annual meeting of the Society of Mining Engineers of AIME; New York, New York, USA (16 Feb 1975).

See CONF-750204—P2.

Melting of cathode copper in the reverberatory, the electric arc furnace and the Asarco shaft furnace is analyzed in order to evaluate specific capacity, process fuel equivalent and the energy efficiency for each process. The Asarco furnace possesses considerably higher specific capacity and energy efficiency than the reverberatory as a result of the basic design for countercurrent flow. The electric arc furnace has lower energy efficiency than the reverberatory (with a waste-heat boiler) because the inefficiency in generation of electric power from fuel more than outweighs the very low heat loss from the electric furnace.

39745 Improvement in thermal efficiency of aluminum reverberatory furnaces. Mangalick, M.C. (Carborundum Co., Solon, OH). pp 101-120 of In Energy use and conservation in the metals industry. Chang, Y.A. (ed.). New York; Metallurgical Society of AIME (1975).

From Annual meeting of the Society of Mining Engineers of AIME; New York, New York, USA (16 Feb 1975).

See CONF-750204—P2.

More than a million tons per year of secondary aluminum and about four million tons per year of primary aluminum go through reverberatory furnaces in this country. The thermal efficiency of these melting furnaces can be improved by: molten metal circulation; preheating the charge; and preheating the combustion air. Molten metal circulation increases the various heat transfer coefficients. Submerged discharge molten metal pumps generate the necessary flow patterns. In established industrial applications, the melting rates have been increased by up to 67 percent, with up to 27 percent lower fuel consumption. Increased melting rates reduce the metal losses due to oxidation. The melt homogeneity, both in temperature and composition, approaches 100 percent. The above industrial experiments are described and the results are analyzed to highlight the underlying causes for the improvements. Various methods for achieving the circulation are also described.

39746 Electric copper matte furnace energy and material balances in the system roaster—smelter—converter. Effect on gas balance and acid plant economy. Ydstie, B. (Elkem-Spigerverket, Oslo). pp 131-155 of In Energy use and conservation in the metals industry. Chang, Y.A. (ed.). New York; Metallurgical Society of AIME (1975).

From Annual meeting of the Society of Mining Engineers of AIME; New York, New York, USA (16 Feb 1975).

See CONF-750204—P2.

The smelting of sulfide ores in electric furnaces is not a new development. The first successful tests with electric furnaces for copper matte was made in the Sulitjelma Mines in 1911 to 1912. However, due to the depression after the first World War a commercial furnace was not in operation until 1929. Since then quite a number of electric furnaces have been installed for copper, copper/nickel, nickel and cobalt/copper/nickel mattes, so that now more than 24 units ranging from 2400 kVA to 51,000 kVA are in operation, smelting more than 6 million tons of concentrates per year. The general concern about SO_2 pollution from metallurgical treatment of sulfide ores has brought a number of new processes and equipment into focus. A proposal for solving the air pollution problems at the old Sulitjelma electric copper smelter is described and the electric furnace as an alternative solution to the general problem is discussed. The electric furnace is versatile, easy to operate and control, and lends itself to almost any kind of sulfide ores and concentrates. In combination with a fluosolid roaster and normal Pierce Smith converters the smelter gives SO_2-concentrations in the combined gases which are well suitable for sulfuric acid production without oxygen enrichment in any step of the process.

39747 Effective energy utilization from direct electric ironmaking. Ban, T.E. (McDowell-Wellman Engineering Co., Cleveland). pp 173-188 of In Energy use and conservation in the metals industry. Chang, Y.A. (ed.). New York; Metallurgical Society of AIME (1975).

From Annual meeting of the Society of Mining Engineers of AIME; New York, New York, USA (16 Feb 1975).

See CONF-750204—P2.

A prereduced pellet smelting process is described which utilizes noncaking qualities of coal and the pellets become bonded largely by ceramic and metallic bonds. The continuous aspects of the process without intermittent cooling steps enable high efficiency and complete fuel utilization to be realized without production of fuel by-products. Thermochemical studies coordinated with pilot plant data show energy requirements as based on coal consumption to be significantly less than that experienced with the blast furnace smelting system which encompasses energy expended from the coke oven and agglomeration plants as well as the blast furnace smelter. A very rapid conversion of fine particulates within the composite pellet takes place in the traveling grate process. Within 20 minutes more than 50 percent of the thermal and chemical conversion of smelting is attained and the normal quenching operations of coke ovens and ore agglomeration plants are avoided.

39748 Iron reduction with concurrent production of fuel gas in shaft reactors. Walsh, J.H.; Reeve, D.A. (Dept. of Energy, Mines, and Resources, Ottawa). pp 189-202 of In Energy use and conservation in the metals industry. Chang, Y.A. (ed.). New York; Metallurgical Society of AIME (1975).

From Annual meeting of the Society of Mining Engineers of AIME; New York, New York, USA (16 Feb 1975).

See CONF-750204—P2.

The co-production of iron and fuel gases from composites of iron oxide and carbon in metallurgical-type countercurrent reactors, such as cupolas or low shaft furnaces, is examined. For the purposes of thermochemical calculations, the reference case is considered of a no-loss reactor charged with pure iron oxide and carbon and blown with preheated air to produce iron at 1600°C and top-gas at 327°C. For this case, the nominal calorific value of the top-gas ($CO:N_2$, 46:54) is calculated to be 158 BTU/ft³ (59 percent of energy of carbon in net top-gas). If coal is used in the reactor, for a high volatile coal (70 percent fixed carbon) the top-gas calorific value becomes 206 BTU/ft³, whereas for a charred low-rank coal (70 percent fixed carbon, 20 percent ash) the top-gas calorific value is 168 BTU/ft³. If CO_2 is produced in the reactor tuyere zone (as in the case of a cupola), the energy balance calculation indicates a top-gas of nominal calorific value of 140 BTU/ft³ (51 percent of energy of carbon in net top-gas). Pre-reduction of the iron oxide without consumption of fixed carbon is calculated to provide a top-gas with nominal calorific value of 156 BTU/ft³ (59 percent of energy of carbon in net top-gas). For the special case of a "coke-less" cupola oxidizing the fuel carbon to carbon dioxide with an agglomerate carbon stoichiometry to manufacture iron from prereduced FeO, the nominal top-gas calorific value is only 82 BTU/ft³, or 102 BTU/ft³ if a high volatile coal is used with 70 percent fixed carbon (35 percent of energy of coal in net top-gas). Finally, an ideal process using a "sliding block"furnace to produce iron and fuel gas is outlined.

39749 Coal for blast furnace injection. Fletcher, L.N. (Armco Steel Corp., Ashland, KY); Garbee, A.K. pp 203-217 of In Energy use and conservation in the metals industry. Chang, Y.A. (ed.). New York; Metallurgical Society of AIME (1975).

From Annual meeting of the Society of Mining Engineers of AIME; New York, New York, USA (16 Feb 1975).

See CONF-750204—P2.

The tuyere level injection of pulverized coal is currently practiced at the Ashland, Kentucky blast furnaces of the Armco Steel Corporation. More than 600,000 net tons have been injected. This technique is utilized to replace part of the blast furnace coke requirement. Using metallurgical coal for injection, 1.1 lbs of coke are replaced/lb of coal injected. Nonmetallurgical coals have also been used. The higher ash injection coals are reported to replace 0.78 lb of coke/lb of coal injected. Low ash noncoking coals have potential for maximizing replacement ratios. Injected coals are shown to influence hot metal chemistry.

39750 Low cost oxygen plant for blast furnace. Sasaki, Y. (Kawasaki Steel Corp., Okayama, Japan). pp 219-236 of In Energy use and conservation in the metals industry. Chang, Y.A. (ed.). New York; Metallurgical Society of AIME (1975).

From Annual meeting of the Society of Mining Engineers of AIME; New York, New York, USA (16 Feb 1975).

See CONF-750204—P2.

An oxygen plant solely for blast enrichment was installed in February 1974 at Mizushima, Okayama Pref. Works of Kawasaki Steel Corporation. One of Japan's newest steel plants started in 1967, Mizushima Works today turns out 10 million tons raw steel with four blast furnaces (4,500, 6,000, 7,300, and 10,000 tons per day nominally) and six LD furnaces (180 tons x 3 and 250 tons x 3). Before the installation of the new oxygen plant, Mizushima Works produced an oxygen of 99.6 percent purity for LD furnaces for metallurgical reasons, and the excess oxygen was used for blast enrichment. However, as the 99.6 percent purity oxygen was not necessary for blast enrichment, the new oxygen plant to produce a 90 percent purity was installed only for blast enrichment. The 90 percent purity was selected considering both installation cost and operation cost. Another change of the new oxygen plant for blast enrichment is the location of inlet of the produced oxygen. The inlet was formerly placed after the blast blower, but it is now before the blower. If the inlet is located after the blast blower, the pressure of oxygen should be balanced with the pressure of blast. Actually, as the pressure of blast is different in each blast furnace, the selected oxygen pressure should be at least equal to the highest blast pressure. On the contrary, if the inlet is located before the blast blower, the pressure of produced oxygen can be lowered to the pressure of the atmosphere, thereby the oxygen turbo compressor can be omitted. The cost of oxygen produced by the new plant comes down to half the cost of oxygen for LD furnaces.

39751 Minicomputer control of fuel dispatching in steel plants. Schroeder, D.L. (Process Corp., Pittsburgh). pp 237-248 of In Energy use and conservation in the metals industry. Chang, Y.A. (ed.). New York; Metallurgical Society of AIME (1975).

From Annual meeting of the Society of Mining Engineers of AIME; New York, New York, USA (16 Feb 1975).

See CONF-750204—P2.

Cost and availability of fuels dictate that steel plants develop control systems to manage fuels that are available and to selectively commit them to usage. Depending on the type of steel plant involved, internally generated fuels such as coke oven and blast furnace gases as well as external fuels (coal, oil, electricity and natural gas) are available for usage. In the utilization and conservation of fuel for minimizing energy cost, there are two important steps to be taken. One is to determine the criterion by which fuels are to be committed to production and, the other, the control of the usage of the fuels to that criterion. A minicomputer system can provide effective and economic control of fuel dispatching in a steel plant. Fuel utilization facilities in a steel plant are described, criteria for optimizing their usage are developed, and the use of minicomputers to control fuel dispatching within a steel plant is illustrated.

39752 Gas turbine topping for increased energy recovery in sulphuric acid manufacture. Harman, R.T.C.; Williamson, A.G. (Univ. of Canterbury, Christchurch, New Zealand). *Appl. Energy;* **3**: No. 1, 23-40(Jan 1977).

The use of a gas turbine as the primary combustion stage in a contact sulfuric acid process is examined and a significant advantage in the energy recovery revealed. For a typical case, the net energy recovery as electric power is improved by 60 to 70 percent over that possible with simple steam-raising equipment. The overall economics of the concept and the potential for energy savings are discussed. Whether or not this potential advantage can be realized depends on a number of factors including fuel feed and combustion chamber design. However, the most serious uncertainty is the corrosion resistance of the turbine materials to an atmosphere of sulfur dioxide, oxygen and nitrogen. These factors are examined.

39753 Energy-conserving, fast-cooling heat treating furnace. McCoy, J.F. (to Alco Standard Corp.). US Patent 4,009,872. 1 Mar 1977. Filed date 25 Jun 1977. 4p.

A heat treating furnace is described which includes a vessel formed by inner and outer spaced apart walls, there being a hollow jacket between the walls. During the heating cycle, a vacuum is maintained in the jacket to reduce heat loss from the vessel and to keep the outer wall cool to the touch. During the cooling cycle, liquid is circulated through the jacket to cool the inner wall and to cool quenching gas being circulated within the vessel.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 39653

39754 Recovery steam boilers. Hinchley, P. (Imp Chem Ind Ltd, Engl). *Termotecnica (Milan);* **30**: No. 9, 482-488(Sep 1976). (In Italian).

A description of the types of equipment is given that is available for increasing the output of steam by recovering the heat of the process gas and of the combustion gas in furnaces. An analysis of the problems presented by different types of boilers is given. The causes of these problems and their solutions are indicated. It is known that recovery boilers are potentially the main cause of low reliability of process plants and of high-capacity single-flow plants, as e.g. ammonia plants: the loss due to a single rupture can exceed the initial value of the equipment. These boilers demand great attention at energy state of design, construction, and operation.

39755 System for recovering heat from the exhaust gases of a heat generator. Lisankie, J.R.; Kratsios, G. (to Foster Wheeler Energy Corp.). US Patent 4,012,191. 15 Mar 1977. Filed date 18 Jun 1975. 4p.

A system is described for recovering heat from the exhaust gases of a heat generator in which a conduit connects the heat generator to the discharge stack and a fan forces the hot gases from the heat generator to the stack. A heat recovery unit removes heat from the gases as they pass through the conduit and an inner stack is disposed in the discharge stack and has an inlet in communication with the conduit and an outlet for discharging the gases. An additional conduit connects the heat generator to the discharge stack for permitting a natural flow of the gases from the heat generator to the discharge stack during inoperation of the fan.

RECYCLING

REFER ALSO TO CITATION(S) 39741, 40070

ELECTRIC POWER

REFER ALSO TO CITATION(S) 39668, 39682

INDUSTRY

REFER ALSO TO CITATION(S) 39737

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 39460, 39537, 39713, 40069

39756 (COO—2983-2) **Energy and protein production from pulp mill wastes. Progress report, September 15, 1976—December 15, 1976.** Jurgensen, M.F.; Patton, J.T. (Michigan Technological Univ., Houghton (USA)). 15 Dec 1976. Contract EY-76-S-02-2983. 8p. P 02/MF A01.

Significant progress was made during the past quarter in establishing the operability and reliability of major pieces of equipment needed for the production of protein and methane from spent sulfite liquor (SSL). Batch ozonations of SSL were conducted at times varying from 1 to 6 hours at pH's in the range of 10 to 2. These screening experiments consistently indicate that low ph's favor the breakdown of SSL into organic fragments which are more easily assimulated by micro-organisms. Approximately 23% of the organics are oxidized at all pH levels indicated that ρH has no effect on the total oxidation of SSL. As was expected total sulfur content of SSL is not measurably altered by ozonation. The intense brown color of SSL is appreciably removed during ozonation. The contents of the reactor assume a light brownish-yellow hue during the course of a 4 hour ozonation treatment. Attempts to quantify the reduction have not been successful to date.

39757 (PB—259764) **Study of the feasibility of a regional solid waste derived fuel system in the Tennessee Valley Authority service area.** (Tennessee Valley Authority, Chattanooga (USA)). Jul 1976. 229p. (PRS—8). Q 11/MF A01.

Sponsored in part by Federal Energy Administration, Washington, D.C. and Environmental Protection Agency, Washington, D.C.

An evaluation of the feasibility of the economics of establishing a resource recovery system in the TVA region is presented. This system would consist of collecting, transporting and processing of the municipal solid waste: (1) processing municipal solid waste and burning the fuel fraction with coal in a conventional TVA power boiler modified for that purpose, and (2) converting municipal solid waste to a synthesis gas with subsequent conversion to fuel grade methanol for use in TVA's gas turbines modified to accept such a fuel.

39758 (PB—260860) **Comprehensive solid waste management study of energy and resource recovery, Chautauqua County, New York. Summary report.** (New York State Dept. of Environmental Conservation, Albany (USA); Polytechnic Inst. of New York, Brooklyn (USA). Dept. of Transportation Planning and Engineering; Gilbert/Commonwealth Associates, Reading, Pa. (USA)). Aug 1976. 21p. Q 02/MF A01.

Prepared by Gilbert/Commonwealth Associates, Reading, Pa. Prepared in cooperation with Chautauqua County Planning Board, Mayville, N.Y. See also PB—260861.

Resource recovery from wastes generated in Chautauqua County is analyzed in this comprehensive study. Presently there is about 8.26 pounds of municipal, commercial and industrial solid wastes generated each day for each person in the County or 192,100 tons per year. By 1985 it is projected that this will increase to 204,715 tons per year. Of these totals approximately 70% of municipal-commercial wastes and 50% of the industrial wastes are combustible and, therefore, present an energy recovery potential. The noncombustible portions present materials recovery potential. The feasibility potential of energy/materials resource recovery from Chautauqua County wastes is evaluated.

39759 (PB—260861) **Comprehensive solid waste management study of energy and resource recovery, Chautauqua County, New York.** (New York State Dept. of Environmental Conservation, Albany (USA); Gilbert/Commonwealth Associates, Reading, Pa. (USA); Chautauqua County Planning Board, Mayville, N.Y. (USA)). Aug 1976. 414p.

Prepared by Gilbert/Commonwealth Associates, Reading, Pa. Prepared in cooperation with Chautauqua County Planning Board, Mayville, N.Y. See also PB—260860.

A comprehensive study of solid waste generation in Chautauqua County and the potential for energy and materials recovery from these wastes are described. There are six major topics discussed, all concerning the feasibility evaluation of a municipal waste resource recovery system. These topic areas are: the existing solid waste disposal system and determination of waste quantities for design parameters by a field weighing program; examination of existing and potential energy and materials markets which would utilize the recovered waste products; review of existing energy resource recovery technologies applicable to Chautauqua County energy markets; study of waste transport schemes for various resource recovery processing plant/fuel user locations; determination of specific solid and gaseous refuse derived fuel systems and application to site-specific energy user conditions; and suggested implementation strategy.

39760 **Process for the manufacture of fillers from solid waste.** Dreer, G. US Patent 4,012,231. 15 Mar 1977. Priority date 15 Feb 1974, German, Federal Republic of (F.R. Germany). 4p.

A process is described for the production of fillers from solid waste which is first ground, magnetically freed from iron particles, supplied with sewage sludge or water, fractionated into portions of different size and treated in a fermentation process for about 24 h at 65°C while air is continuously fed such that while the compost is being fermented. A solvent is added to the mixture in a range of 1 to 2 to 4 parts by weight compost to solvent, said treatment continuing for 10 to 16 h, dried, and to the dried product, chlorinated paraffin and antimony trioxide are added thereto.

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

REFER ALSO TO CITATION(S) 39794

39761 **Influence of combustion with pressure exchange on the performance of heat balanced internal combustion engines.** Pouring, A.A.; Blaser, R.F.; Keating, E.L.; Rankin, B.H. Warrendale, PA; Society of Automotive Engineers (1977). 12p. (CONF-770205—68).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The heat balanced or combined cycle engine with time dependent combustion sustained by two chamber geometry is demonstrated experimentally. Evidence of time dependent heat addition is given where combustion creates a field of pressure waves sustained by pressure exchange between two chambers. The basic cycle and operating characteristics are reviewed and experimental results with CFR and glass-walled engines demonstrate the engine characteristic as compared to OTTO engines. Improvements in thermal efficiency over the OTTO engine in excess of 45 percent are demonstrated in some operating regimes. Considerable reduction in peak pressure and exhaust emission is also demonstrated.

SPARK-IGNITION

REFER ALSO TO CITATION(S) 39797, 39826

39762 **Effects of swirl and squish on S.I. engine combustion and emission.** Nagayama, I.; Araki, Y.; Iioka, Y. Warrendale, PA; Society of Automotive Engineers (1977). 11p. (CONF-770205—6).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The effect of intensified swirl and squish on combustion and emissions in a spark-ignition engine was studied using a four cylinder, 1.4 liter engine. Swirl was intensified by modifying intake port angle and squish was controlled by modifying squish area and clearance. From the test results it was found that the increased intensity of swirl, squish and swirl-squish combination was highly effective to increase burning velocity, to improve cycle to cycle combustion fluctuation, fuel economy and driveability. Especially, it was shown that swirl was effective in the initial stage of combustion and swirl-squish combination was influential in the whole stage of combustion.

39763 **Heat balance provides insight into modern engine fuel utilization.** Ament, F.; Patterson, D.J.; Mueller, A. Warrendale, PA; Society of Automotive Engineers (1977). 12p. (CONF-770205—7).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Heat Balance Studies were conducted on a 1975 production 5.74 liter V-8 and an experimental 3.69 liter V-6 to determine sources of fuel economy differences when they were installed in a vehicle. Heat balance results, friction and fuel economy were explored during dynamometer tests simulating road load. Comparisons were made with and without certain emission control features. With comparable calibrations, the road load indicated efficiency was nearly the same for each engine, as it would be installed in a vehicle with an appropriate axle ratio. The results suggest that engine friction and not combustion efficiency accounted for the major fuel economy difference.

39764 Engine control optimization for best fuel economy with emission constraints. Rishavy, E.A.; Hamilton, S.C.; Ayers, J.A.; Keane, M.A. Warrendale, PA; Society of Automotive Engineers (1977). 17p. (CONF-770205—43).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

This new approach for improving fuel economy uses computer programs to optimize and tailor an engine's fuel, EGR and spark control in the laboratory. New forms of engine and vehicle test data are used as inputs. This includes a simple simulation of the catalytic converter. The emission engineer is in control of the process via a special interactive program at a computer terminal. He combines his know-how with the computer programs to create a feasible engine control calibration for vehicle evaluation. The programs can also be used to study tradeoffs of optimized fuel economy vs. emissions for a vehicle. Although presently limited to warmed up operation, the optimization procedure has proved to be valid and useful.

39765 Engine mapping methodology. Baker, R.E.; Daby, E.E. Warrendale, PA; Society of Automotive Engineers (1977). 15p. (CONF-770205—44).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Developing engine calibrations to help achieve improved fuel economy, emissions and performance has become an increasingly complicated task as emission standards become more stringent and fuel economy standards become effective. A methodology was devised to project the economy that a specific vehicle could achieve over a selected driving cycle. This method can be used to determine the potential of control systems, exhaust treatment devices and drivetrain configurations to improve economy at specified emission levels. Optimum engine calibrations are defined to utilize these devices fully, from which automatic engine calibration strategies can be developed for vehicle verification.

39766 Computerized five parameter engine mapping. Vora, L.S. Warrendale, PA; Society of Automotive Engineers (1977). 13p. (CONF-770205—53).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Systematic and computerized mapping procedures were developed to characterize the performance of an engine as a function of speed, load, ignition timing, air-fuel ratio, and percent of exhaust gas recirculation. Using these techniques a map of a carbureted, 5.7 liter, spark ignited V-8 engine was obtained. This five parameter map data base resides in a large computer system which allows access by multiple users. The mapping procedures combine a rational approach to the selection of speed-load points for engine mapping with a computerized test incorporating a slow sweep of the independent variables with simultaneous data acquisition. The result is more accurate engine characterization data with less effort and in less time than is possible with conventional procedures. The high data density of this map enabled the development of valid models for fuel and emissions by curve fitting techniques.

39767 Computerized on-line approach to calculating optimum engine calibrations. Cassidy, J.F. Warrendale, PA; Society of Automotive Engineers (1977). 17p. (CONF-770205—54).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

A current design objective of the automotive engineer is to calibrate the passenger car spark ignited engine for best fuel economy for a given level of exhaust emission performance. The need to achieve the best possible calibrations has motivated the application of mathematical optimization techniques to this problem. A new on-line technique is described in which an engine dynamometer minicomputer, programmed with an optimization algorithm, automatically determines the optimum calibrations for spark advance, air-fuel ratio, and exhaust gas recirculation at fixed speed-load operating points. These points are selected by analysis of measured or simulated performance of the engine in a specified vehicle.

39768 Variable-displacement spark-ignition engine. Pouliot, H.N.; Delameter, W.R.; Robinson, C.W. Warrendale, PA; Society of Automotive Engineers (1977). 20p. (CONF-770205—69).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

A five-cylinder variable displacement research engine has been designed, built, and tested for over one year. Displacement is varied by changing the piston stroke using a four-bar linkage. By proper choice of the linkage dimensions, compression ratio can be held constant as the stroke changes, or it can be tailored to optimize economy and performance. Before the engine was built, its dynamics were thoroughly analyzed, and a five-cylinder configuration was selected to minimize vibration. Test data show that BSFC is, as expected, less dependent on load than in conventional engines, and averages less than 0.5 lb/bhp-hr over the load and speed range of ordinary automobile operation. Several methods for estimating urban fuel economy from dynamometer data predict a significant improvement compared with conventional engines. Emission controls have not yet been applied to this engine.

DIESEL

REFER ALSO TO CITATION(S) 39795, 39796, 39802

39769 Piston design and its reliability for Kawasaki-Man low-speed large-bore diesel engines. Akashi, G.; Nakano, H.; Shimizu, K.; Fujimori, T.; Maehata, S.; Nakamura, Y.; Sato, S. *Kawasaki Giho;* No. 62, 232-239(Dec 1976). (In Japanese).

In the past, the components of the combustion chamber of marine diesel engines were designed primarily on the basis of experience because of its complicated shape and the many influential factors on its fatigue strength. However, more accurate and reliable designs must now be employed for these components because they have been exposed to more severe conditions. When designing such components, it is necessary to examine the reliability of the component by evaluation of its stress level, which is analyzed by the finite element method and confirmed by measurements, based on experience with these components or the data obtained from fatigue strength tests. Problems and solutions concerning the water-cooled cast-steel piston crown and investigations into quality assurance for the design of the newly developed forged-steel built-up type piston crown are mentioned as examples. Findings regarding the designing of combustion chamber components and the reliability of piston crowns in Kawasaki-Man low-speed large-bore diesel engines are also discussed.

39770 Low NO/sub x/ lightweight car diesel engine. Hill, S.H.; Dodd, J.L. Warrendale, PA; Society of Automotive Engineers (1977). 29p. (CONF-770205—2).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

A new automobile diesel engine concept was developed to the preliminary engine design level and demonstrated by simulating vehicle tests with a computer model using steady state engine dynamometer data. The preliminary design is a six cylinder, swirl chamber diesel of 209 CID and 130 GHP. This concept engine weighs 495 pounds and employs turbocharging, variable compression ratio, high prechamber-main chamber volume ratio and exhaust gas recirculation. An existing automobile diesel was modified to simulate the concept engine and steady state engine tests were conducted. Test results were converted to urban cycle results for a 3000 pound GVW vehicle through the use of a computer model. Emission results (Grams/Mile) are .21 NO/sub X/, .24 HC, and 1.24 CO. Fuel consumption (Miles/Gallon) is 30.3 urban cycle and 36.4 highway cycle. Vehicle cycle results at 3700 pounds GVW meet all emission requirements and exceed the future 27.5 MPG requirement by ten percent. Multifuel capability and 175 PSI BMEP power levels were also demonstrated.

TURBINE

39771 Low-cycle fatigue and creep analysis of gas turbine engine components. Majumdar, S. (Argonne National Lab., IL). *J. Aircr.;* 12: No. 4, 376-382(Apr 1975).

Accurate analytical prediction for low-cycle fatigue and creep damage of actual turbine components is still beyond the state-of-the-art. Analytical procedures, such as indicated in this paper, can at best provide a relative measure of the severity of damages encountered by the same engine under various loading histories. Coupled with extensive low-cycle fatigue and creep testing of critical engine components during engine development, these procedures might lead to an effective way of estimating engine damage incurred during the operation of the aircraft. Much research work along these lines is still needed.

39772 Development of diesel hydraulic locomotive with wireless control and automatic train operation equipment. Fujinawa, T.; Fujita, H.; Kishimoto, T.; Mizoshita, F.; Shimizu, K. *Kawasaki Giho;* No. 62, 177-182(Dec 1976). (In Japanese).

A new diesel hydraulic locomotive with wireless control and automatic train operation equipment for operation in iron works has been developed. This diesel hydraulic locomotive enables its operator to carry out train operation in the yard, such as track switching, coupling or uncoupling of wagons, due to the simplified driving method and automatic train operation equipment. The driving method employs a 250 MHz band radio for remote control which does not require a radio license for operation. The locomotive is equipped with wide operating floors at both ends and minimal number of indicators for locomotive operation. The diesel engine,

torque converter and gearbox were improved for automatic train operation from technical operation experience.

EXTERNAL COMBUSTION ENGINES

STIRLING CYCLE

REFER ALSO TO CITATION(S) 39798, 39799, 39800

39773 (COO—2631-18) **80-100 HP Stirling engine feasbility study. Progress report No. 18, for the quarter October—December 1976.** Postma, N.D. (Ford Motor Co., Dearborn, Mich. (USA)). 1976. Contract EY-76-C-02-2631.M001. 7p. P 02/MF A01.

Progress is reported for a program to investigate the use of an 80 to 100 hp Stirling engine in a 2500 to 3000 lb. passenger car. The engine was installed in a dynamometer test cell, and dynamometer emissions of HC, CO, and NO/sub x/ were measured. Fuel economy data are also given, and various engine design modifications (seals, fuel system, exhaust gas recirculation system, burner) are discussed. (PMA)

ELECTRIC-POWERED SYSTEMS

39774 Automated control systems of the Morgantown personal rapid transit system. Elias, S.E.G.; Barker, T.C.; Hendershot, R.B. (West Virginia Univ., Morgantown). pp 269-273 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

The design, performance, and control system of the computer-controlled, fully automated collection and distribution transportation system at West Virginia University (Morgantown) are described. This is a six-station system connected by 9.4 mi of single guideway, half of which is in operation. Each electrically powered vehicle, capable of carrying up to 20 passengers, is heated and air conditioned and can operate either on-demand or pre-scheduled service. The control and communications subsystems in the control center, or in stations, vehicles, and guideways are described, operation during the first year is discussed, and the simulation of fleet utilization, of factors affecting operation, and of the control system are described. (LCL)

39775 Simulation study of a demand-actuated transportation system. Lee, J.G.; Vogt, W.G.; Mickle, M.H. (Univ. of Pittsburgh). pp 274-280 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

A simulation of a demand-actuated transportation system is studied, using two simulators, PICTS (Pitt Continuum Transportation Simulator) and PINTS (Pitt Network Transportation Simulator). PICTS and PINTS simulate a demand actuated type service in a finite geographical area of operation, PICTS using straight line approximation for distance traveled and PINTS using actual street network distance. Both are calibrated for the Haddonfield, New Jersey area using the Haddonfield street network matrices prepared by the University of Pittsburgh and Haddonfield DIAL-A-RIDE system operational data prepared by the MITRE corporation. The analysis of the data gives the values of input parameters and the simulated demand sequences for both simulators, which take the part of input data. With these input data, PICTS and PINTS are exercised for evaluation and comparison. The results are observed in the way that PICTS and PINTS are compared by adopting the Haddonfield DIAL-A-RIDE operational data as a benchmark. The mean level of service and the mean waiting time are used as the transportation system performance indices. The level of service for a trip is defined to be the ratio between the time spent for the trip using a private automobile and the time using other modes of travel. The waiting time for a demand is defined to be the difference between the time at which demand occurred and the time at which transportation arrives to service the demand.

39776 New developments in magnetic suspension and propulsion for transportation. Holt, W.J.; Ross, J.A. Warrendale, PA; Society of Automotive Engineers (1977). 7p. (CONF-770205—21).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The most recent accomplishments in the on-going development of the magnetically levitated and propelled ROMAG transportation vehicle are described. Recent improvements, reliability analyses, and tests have proven more forcefully that ROMAG is ready for extended application in the arena of public transportation.

39777 Design of electric commercial vehicles for production. Harding, G.G. Warrendale, PA; Society of Automotive Engineers (1977). 10p. (CONF-770205—58).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Development of high performance electric vehicles has been pursued both by simple conversions from standard gasoline vehicles, and by designing a purpose-built vehicle in the form of a taxi incorporating novel features. By combining the lower cost of the former method with the greater efficiency of the latter, the Mark III Lucas electric vehicle has been evolved based on a standard van, providing 1 ton payload capacity. The compact drive package can be fitted to a variety of vehicles at the initial manufacturing stage. Some of the implications for distribution and servicing of quantity-produced electric vehicles are considered.

39778 Battery powered jeep and van performance. Dowgiallo, E.J. Jr.; Snellings, I.R.; Blake, W.H. Warrendale, PA; Society of Automotive Engineers (1977). 8p. (CONF-770205—59).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

A postal jeep and a commercial delivery van were evaluated. Energy data from operation over a test loop and various grades are presented for zero to 15 mph start/stop and 30 mph range runs. Test results are summarized in a graph for prediction of remaining miles based on route terrain. Jeep regenerative braking is discussed. A high power electrical simulator was used to reproduce a mountainous terrain load profile. The simulator was programmed with magnetic tapes made up from actual field recordings. This verified calculations, gave additional battery information and eliminated the need for a mountainous terrain test track.

39779 Actual operating experience of lead-acid batteries for electric milk delivery cars. Nagano, T.; Maegawa, O.; Kamada, K.; Okazaki, I. Warrendale, PA; Society of Automotive Engineers (1977). 7p. (CONF-770205—60).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

An electric milk delivery car, using lead-acid batteries as the power source, has been put into practical use for about four and a half years. From the data obtained during these years, its feasibility was confirmed and some problems in battery handling were made clear to make most effective use of battery.

39780 Clean transportation for new towns: DAIHATSU electric vehicles in the Senboku area. Honda, S.; Sugitani, M.; Yumoto, I.; Kawakatsu, S. Warrendale, PA; Society of Automotive Engineers (1977). 13p. (CONF-770205—61).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Senboku is the name of a new town which is expected to become a model area of clean transportation in Japan. The transportation of peoples and goods would be systematized, and some kinds of electric vehicles would be used as its means with the valuation of non-pollution. Inside of Senboku area, a joint home delivery experimental test, using our newly developed electric cab-van of DAIHATSU ES40V, was finished. The electric propulsion systems, specification and performance of ES40V are discussed as well as its quick-charging system.

39781 High energy nickel—zinc battery for electric vehicles. von Krusenstierna, O.; Reger, M. Warrendale, PA; Society of Automotive Engineers (1977). 9p. (CONF-770205—62).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Before far-term high energy electric vehicle batteries are developed, near-term lead-acid and intermediate batteries with energy densities 40 to 80 Wh/kg can meet the energy demands of a large number of commuter and delivery cars. A new nickel-zinc battery is described with energy densities of 50 to 80 Ah/kg depending on the choice of nickel cathodes. A vibration charging technique completely eliminates the zinc dendrite and shape effects, and the nickel cathodes therefore determine the lifetime. A 2 kW battery was deep cycled for 1200 cycles, and traction cells up to 350 Ah were field tested in vehicles.

39782 Application of the Ford sodium—sulfur battery in electric vehicles. Unnewehr, L.E.; Minck, R.W.; Owens, C. Warrendale, PA; Society of Automotive Engineers (1977). 9p. (CONF-770205—63).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The Ford Sodium—Sulfur battery is evaluated for applications in electric vehicles. The required power and energy ratings of a

battery to achieve acceptable performance and driving range for a specific commuter-type vehicle are calculated and discussed. The relative merits of the use of mechanical transmissions and regenerative braking in electric vehicles are explored. Volumes and weights of several battery packages based upon realistic NaS cell designs are calculated, and the thermal management problems of these high-temperature battery packages during the varying power levels required in vehicular applications are discussed.

39783 Charge-discharge behavior of the C.G.E. circulating zinc—air vehicle battery. Appleby, A.J.; Jacquelin, J.; Pompon, J.P. Warrendale, PA; Society of Automotive Engineers (1977). 10p. (CONF-770205—64).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The primary unit of the C.G.E. zinc—air electric vehicle battery has been described in previous publications. It consists of a constant cross-section tubular fuel cell using zinc powder in circulating 12 N KOH solution. All the reaction product (zincate) is maintained in colloidal solution. The system is capable of lifetimes in excess of 1,800 hours and will be of low cost. A discussion is given of the technical aspects of recharge of the system, which, in contrast to the primary cell, is still in the laboratory engineering stage. The limitations of the system are discussed and the overall performance based on different parameters is given. A number of different economic options are examined.

39784 Cost of fuels for fuel cell automobiles. Bush, W.V. Warrendale, PA; Society of Automotive Engineers (1977). 15p. (CONF-770205—65).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The cost of operation projected for a fuel cell automobile could be as much as 1 to 2 cents/mi less than for a comparable internal combustion engine car or an all-battery car, assuming energy raw material cost equilibrated at 10$/bbl crude oil equivalent. Fuel cost is a small but significant element in total operating cost. Therefore, the projected cost advantage of the fuel cell automobile increases with increasing cost of fossil fuel, because of the higher energy efficiency projected for the fuel cell automobile.

39785 Energy exchanger for an electrical vehicle. Lombard, C. (to Regie Nationale des Usines Renault). US Patent 4,010,407. 1 Mar 1977. Priority date 7 Mar 1974, France. 6p.

An energy exchanger for a battery driven vehicle comprising two rotatable electrical machines connected on the same shaft, one of high voltage, the other of low voltage. The electrical machines can each be operated in generator or motor modes and the machines are electrically connected together to the battery on a vehicle via an electrical control circuit such that the machines exchange energy between themselves and the battery, both to drive the vehicle by battery drain and to recharge the battery when the vehicle is decelerating. The battery can be recharged from an external power supply via the machines which then operate in generator mode.

39786 Battery control system for battery operated vehicles. Finger, E.P.; Marwell, E.M. (to Curtis Instruments, Inc.). US Patent 4,012,681. 15 Mar 1977. Filed date 3 Jan 1975. 6p.

A system is disclosed for monitoring the state of charge of batteries in a fleet of electrically powered vehicles. Each battery has associated with it an integrator module which registers both the depletion and charging of the battery. While the battery is in use in the vehicle, a portion of the current flowing from the battery is sent to the integrator module which registers the current depletion. A readout circuit is also coupled to the integrating device for indicating the condition of the battery while it is in the vehicle. When the battery reaches a predetermined low state of charge, circuitry provided for detecting this condition provides a prewarning signal and on further discharge disables nonessential auxiliary functions in the vehicle, leaving only those systems working which are necessary in order for the driver to be able to return to a battery charging station. At the charging station, the integrator module and the battery are removed from the vehicle and connected at the charging station. During charging, the integrator module is coupled to the charger and a portion of the current leaving the charger passes through the integrator module providing continuous display of the state of charge and information to regulate the charge rate and terminate charge when appropriate ampere hours have been returned to the battery.

39787 Field boost arrangement for separately excited dc traction motors of a vehicle propulsion system. Dickerson, N.K.; Turley, B.J. (to General Electric Co.). US Patent 4,012,680. 15 Mar 1977. Filed date 27 Feb 1975. 24p.

An electrical propulsion control system is described for self-propelled traction vehicles having an electric generator supplying energy to separately excited traction motors. Each motor field is normally excited with a substantially constant field excitation providing magnetic saturation such that motor load variations produce minimal changes in back emf. The excitation of each motor field is equally boosted responsive to the largest one of the individual motor armature currents exceeding a predetermined magnitude which is greater than the maximum attainable armature current during dynamic retarding operation.

39788 Speed control for electrically propelled traction vehicles. Rist, D.H.; Turley, B.J. (to General Electric Co.). US Patent 4,012,677. 15 Mar 1977. Filed date 27 Feb 1975. 24p.

An electrical propulsion control system is described for self-propelled traction vehicles of the type having a prime mover-driven electric generator supplying energy to traction motors and regulating means for maintaining the electrical output of the generator within desired limits. The limit of generator output voltage is varied between zero and a predetermined maximum level as a function of desired vehicle speed.

VEHICLE DESIGN FACTORS

39789 Analysis of the costs, effectiveness, and benefits of aircraft noise reduction programs. Safeer, H.B. (Dept. of Transportation, Washington, DC). *SAE Prepr.;* No. 750595, 1-6(1975).

This document describes the results of cost effectiveness, marginal benefit, marginal cost, and total cost analyses with respect to several noise abatement options being considered by the United States government, including retrofit of aircraft which do not meet the noise level limits of Federal Aviation Regulation Part 36.

39790 Vehicle development of the dual mode bus system. Maki, S.; Tokuda, T.; Takemura, T.; Uchiyama, H.; Sasabe, Y. Warrendale, PA; Society of Automotive Engineers (1977). 16p. (CONF-770205—55).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Work was performed on developing vehicles for the Dual Mode Bus System, and a system which can be technically put into practical application was completed. An outline of the system and vehicle is given. As regards the operational stability of the lateral guidance system, analyses, computations using a simulation model, and experiments using test cars were conducted on two types of guidance systems, a linked type, which is to link mechanically the guidance wheel with the steered wheel, and a non-linked type.

39791 Commercial vehicles and industrial motors (annual survey). Klinkhammer, H. *VDI (Ver. Dtsch. Ing.) Z.;* **119**: No. 5, 273-276(1 Mar 1977). (In German).

The following are discussed: (1) motor performances and admissible vehicle masses; (2) motor acceptances of general validity; (3) exhaust gas and emission prescriptions; (4) noise prescriptions; (5) technical status of the performances of diesel engines for commercial vehicles; and (6) development perspectives and alternative drives.

ENGINE-TRANSMISSION MATCHING

39792 Analytical study of transmission modifications as related to vehicle performance and economy. Chana, H.E.; Fedewa, W.L.; Mahoney, J.E. Warrendale, PA; Society of Automotive Engineers (1977). 9p. (CONF-770205—56).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

A method of vehicle performance measurement has been developed so that selection of optimum fuel-economy-performance trade-offs can be made for a vehicle having various powertrain components. This method was utilized in an analytical study of drivetrain component features such as—overall ratio range, number of ratio steps, locked converters, continuously variable drives, etc. Both manual and automatic type transmissions are considered. Indications are that ratio range is an important consideration in the selection of transmission design parameters and also conventional transmission concepts can be competitive with the more exotic continuously variable type units.

ENGINE SYSTEM

REFER ALSO TO CITATION(S) 39761, 39770, 39773, 39810, 39814, 39834

39793 Factors affecting the noise from small propeller driven aircraft. Maglieri, D.J.; Hubbard, H.H. (NASA, Washington, DC). *SAE Prepr.;* No. 750516, 1-8(1975).

The factors affecting noise from small propeller driven airplanes are reviewed to quantify their affects where possible, and to indicate the potential for noise reduction. The main sources of

external noise are noted to be the propellers and engines; the airframe being of less importance for both aural detection and community annoyance. Propeller noise is a strong function of tip speed and is affected adversely by nonuniform inflows. Reciprocating engine exhausts are noisier than those of comparably rated turboshaft engines, but their noise can be reduced by the use of flight certified exhaust mufflers. Presently, there are no generally accepted engineering methods for development of optimized propellers and exhaust muffler designs from weight and performance penalty standpoints. Flight demonstration results, however, suggest that required noise reductions for future certification should be possible with potentially small penalties.

39794 Variable displacement internal combustion engine. Pouliot, H.N. (to Energy Research and Development Administration). US Patent Application 690,498. 27 May 1976. 10p.

A description is given of a variable displacement internal combustion engine designed to provide increased vehicular mileage without sacrificing power, to reduce friction losses at cruising speeds, and to reduce engine fuel costs without unduly increasing engine manufacturing and maintenance costs. The novel variable displacement combination comprises a main lnk having two ends, the main link being rotatably connected at one end to the crankshaft, a piston link connected to the piston and to the main link at its second end and a control link connected to the second end of the main link. The position of the control link controls the movement of the second end of the main link relative to the crankshaft to thereby control the length of the stroke of the piston within the cylinder.

39795 Recent CAV research into noise, emissions, and fuel economy of diesel engines. Russell, M.F. Warrendale, PA; Society of Automotive Engineers (1977). 17p. (CONF-770205—4).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The contribution to the external noise from the combustion process was considered in relation to the gaseous emissions, smoke and specific fuel consumption. To satisfy the requirements of proposed legislation in different markets, while maintaining economical operation, the fuel injection equipment for a diesel engine must compromise between several conflicting requirements. The conflicts are presented in the form of "trade-off" curves over a range of dynamic injection timings. Four means to achieve better "trade-off" curves were investigated: higher rate of injection, fumigation, turbocharging, and turbocharging combined with a higher rate of injection.

39796 M.A.N. M-combustion system in the passenger car diesel engine. Neitz, A. Warrendale, PA; Society of Automotive Engineers (1977). 13p. (CONF-770205—23).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The use of the direct-injection "M" combustion system in a small high-speed diesel engine is discussed. Experimental and test results are given for a passenger car whose 60-HP (DIN) four-cylinder engine with 2.2 litres (134 in^3) displacement was converted for the "M" system. The combustion system which is being widely used in commercial vehicle engines possesses advantageous features which make it attractive for use in passenger cars on account of its inherently low fuel consumption and noise level. Modifications of the combustion process which enable substantial improvements to be achieved in exhaust gas quality are described.

39797 Five-cylinder engine as an economical, smooth-running power plant. Hauk, F.; Dommes, W. Warrendale, PA; Society of Automotive Engineers (1977). 10p. (CONF-770205—49).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, Unit. ' States of America (USA) (28 Feb 1977).

For the first time in the history of automobile engineering, AUDI NSU has introduced a 5-cylinder in-line gasoline engine for production cars designed to run at speeds up to about 7,000 rpm. This unusual new design makes it possible to set new standards of performance and smoothness, while still retaining the advantages of front wheel drive.

39798 Design of the 4-215 D.A. automotive Stirling engine. van Giessel, R.; Reinink, F. Warrendale, PA; Society of Automotive Engineers (1977). 15p. (CONF-770205—50).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The Stirling engine holds out prospects of achieving a low pollution, quiet automotive power plant with excellent fuel economy and multi-fuel capability. N. V. Philips, of Holland, has been working with Ford Motor Company since 1972 on a joint program to build, test, and develop a conceptual version of the engine to determine its real potential. A description is given of the approach taken in the design of a four-cylinder double-acting 170-hp Stirling engine with a swash-plate drive, suitable for passenger car installation. Performance and steady-state fuel economy measured on a dynamometer are also presented.

39799 Development of a 150 kW (200 hp) Stirling engine for medium duty automotive application: a status report. Rosenqvist, N.K.G.; Gummesson, S.G.; Lundholm, S.G.K. Warrendale, PA; Society of Automotive Engineers (1977). 11p. (CONF-770205—51).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

A status report is given of the development of a 150 kW (200 hp) Stirling prototype engine intended for medium duty automotive application. The basic concept and some of the components were developed on a small 40 kW (55 hp) experimental engine of V4 configuration. In the report emphasis is laid on the presentation of the development of specific Stirling engine components such as heat exchangers and control system. The present status of performance as well as the final objectives are given. The installation of the engine in a truck and projected truck performance in a typical driving cycle are presented and discussed.

39800 Design considerations on a thermal energy storage Stirling engine automobile. Asselman, G.A.A.; Spigt, C.L.; Meijer, R.J. Warrendale, PA; Society of Automotive Engineers (1977). 13p. (CONF-770205—52).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The external heating system of the Stirling engine enables it to be coupled to a variety of energy sources. In the field of unconventional heating systems, a high temperature thermal energy storage unit was built in which, for the heat transport, use is made of the heat pipe principle. Based on experience with this, design considerations are given regarding the performance of an automobile propulsion unit, for which a new concept of a Stirling engine with a variable swash-plate drive and heating by a rechargeable thermal energy storage unit are used.

39801 Lambda-sensor with Y_2O_3-stabilized ZrO_2-ceramic for application in automotive emission control systems. Hamann, E.; Manger, H.; Steinke, L. Warrendale, PA; Society of Automotive Engineers (1977). 7p. (CONF-770205—57).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

A description of a closed loop fuel metering system was given in the SAE-Paper "Closed Loop Exhaust Emission Control System with Electronic Fuel Injection." The component of paramount importance in the control system is the Lambda-Sensor, which has been reported in the SAE-Paper "Ceramic Aspects of the Bosch Lambda-Sensor." A report is given on the work recently done for optimizing the Lambda-Sensor. As a result of this work, the sensor of the latest design is a Y_2O_3-stabilized ZrO_2-sensor whose temperature response is 150°C lower and whose time of response in the CVS-test is the half. Generally, experimental work was concentrated on improvement of thermal, mechanical stability and resistivity against exhaust; operating temperature range; response speed; and working life. The results are given.

39802 Pistons for high output diesel engines. Roehrle, M.D. Warrendale, PA; Society of Automotive Engineers (1977). 17p. (CONF-770205—66).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Along with the increase in specific output of internal combustion engines the thermal and mechanical loadings on the pistons have grown continually. A discussion is given of modern piston designs used on Diesel engines for commercial vehicles, railway traction and marine propulsion. A survey on the comprehensive research and development work on pistons and explanations are given by means of practical examples how part of piston trials can be carried out in the laboratory.

39803 Vaporized fuel for internal combustion engine and method and apparatus for producing same. Feuerman, A.I. US Patent 4,011,843. 15 Mar 1977. Filed date 27 Feb 1975. 10p.

An automobile engine is fueled with a mixture of air and a vapor derived by passing electric current through an electrolytically conductive emulsion of gasoline and water. Specific compositions of the conductive emulsions are disclosed as are unique designs for vaporizers for the fuel.

39804 Method and apparatus for promoting combustion in an internal combustion engine using a catalyst. Pfefferle, W.C. (to Engelhard Minerals and Chemicals Corp.). US Patent 4,011,839. 15 Mar 1977. Filed date 28 Nov 1975. 14p.

An internal combustion piston engine utilizing a catalyst to promote combustion and not requiring spark ignition is described. A catalyst member is provided within the engine cylinder. Air is supplied to the cylinder and is compressed by a piston. At or near the point of maximum compression, fuel is contacted with the catalyst, preferably from the side of the catalyst opposite the piston. The fuel and air mix to initiate combustion and the air-fuel mixture passes through the catalyst member, completing the combustion. The operation can result in relatively complete combustion of the fuel at a relatively low temperature of about 1800° to 3300° or 3500°F, so that little or no undesirable components are present in the engine exhaust, especially since the exhaust may have a low content of nitrogen oxides.

39805 Gas turbine construction. Asplund, H.F. (to United Technologies Corp.). US Patent 4,011,718. 15 Mar 1977. Filed date 1 Aug 1975. 14p.

A gas turbine consisting of alternate stators and rotors so fabricated that all stator vanes, all rotor blades and all blade tip seals may be removed through the engine case without requiring disassembly or translation of major portions of the gas turbine engine.

39806 Control system for a gas turbine. Turner, H.G.; Wood, R.S. (to Plessey Handel und Investments AG). US Patent 4,001,717. 15 Mar 1977. Priority date 23 Nov 1973, United Kingdom of Great Britain and Northern Ireland (UK). 4p.

A control system for a gas turbine is described consisting of a fuel pressurizing pump and two fuel flow restrictors supplied with fuel at different pressures from the pump. The restrictors are in communication with a common fuel pipe line, and a rotenoid varies the fuel pressure in the common fuel pipe line. The varying fuel pressure can then be used for controlling the output of the gas turbine.

39807 Fuel control system for gas turbine engine. Smith, T.S. (to Lucas Industries Ltd.). US Patent 4,011,716. 15 Mar 1977. Priority date 21 May 1974, United Kingdom of Great Britain and Northern Ireland (UK). 2p.

A servo-operated shut-off valve for a gas turbine engine fuel system has a main valve control element and an electrically operated pilot valve control member for controlling a servo-operating pressure for the main valve. The pilot valve control member and main valve control element are resiliently interconnected so that movement of the main valve control element urges the pilot valve control member in a direction to cause the servo pressure to maintain that movement of the main valve control element.

WEIGHT

REFER ALSO TO CITATION(S) 39827

EMISSION CONTROL

REFER ALSO TO CITATION(S) 39796

39808 Emission patterns of diesel-powered passenger cars. Part II. Braddock, J.N.; Gabele, P.A. Warrendale, PA; Society of Automotive Engineers (1977). 12p. (CONF-770205—9).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

An experimental program was conducted to characterize the gaseous and particulate emissions from a 1975 Peugeot 504D light duty diesel-powered vehicle. The vehicle was tested over the 1975 Federal Test Procedure, Highway Fuel Economy Test, and Sulfate Emissions Test driving cycles using four different fuels covering a fair range of composition, density, and sulfur content. In addition to fuel economy and regulated gaseous emission measurements of hydrocarbons, carbon monoxide, and oxides of nitrogen, emission measurements were also obtained for non-regulated pollutants including sulfur dioxide, sulfates, aldehydes, benzo[a]pyrene, carbonyl sulfide, hydrogen cyanide, nonreactive hydrocarbons, and particulate matter. The results are discussed in terms of emission trends due to either fuel type or driving cycle influence.

39809 Emissions from in-use catalyst vehicles. Gibbs, R.; Wotzak, G.; Byer, S.; Johnson, R.; Hill, B.; Werner, P. Warrendale, PA; Society of Automotive Engineers (1977). 38p. (CONF-770205—46).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

A sample of forty-nine 1975 and 1976 catalyst equipped vehicles operated in the Albany, New York area have been tested in "as received" condition for gaseous and particulate emissions at approximately 5,000 mile intervals. Each of the 127 tests includes a 1975 FTP, a one-hour 50 mph steady cruise, and five SET-7 (sulfate) cycles, all run on tank fuel. Test data include HC, CO, NO/sub x/, SO_3, idle HC and CO, soluble particulate sulfate, and fuel economy. Summaries of emission rates are presented as a function of catalyst type, manufacturer, and emission parameters. Specific attention is given to release of stored sulfur during idle periods between test driving modes. Data are also presented on plugged converters found on high mileage police vehicles. This serious plugging appears to be the result of deposition of manganese and oil additive related compounds in monolith cells on cars run of fuel containing MMT additive.

39810 Optimization of automotive engine calibration for better fuel economy: methods and applications. Auiler, J.E.; Zbrozek, J.D.; Blumberg, P.N. Warrendale, PA; Society of Automotive Engineers (1977). 17p. (CONF-770205—47).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

A method is presented for determining an optimum engine calibration that maximizes fuel economy for the CVS-H cycle subject to a set of emission constraints. The method combines the results of a powertrain simulation with steady state engine dynamometer emissions and fuel flow data to project cycle emission and fuel economy values. Dynamic Programming is used to allocate emission contributions among selected speed/load points to maximize projected cycle fuel economy. The corresponding engine calibration is then directly inferred from the optimum emission allocation. Typical results for 2.3 liter and 400 CID engines are presented.

39811 Characterization of sulfate and gaseous emissions from California consumer-owned, catalyst-equipped vehicles. Herling, R.J.; Gafford, R.D.; Carlson, R.R.; Lyles, A.; Bradow, R.L. Warrendale, PA; Society of Automotive Engineers (1977). 14p. (CONF-770205—70).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

A description is given of a study in which approximately 100 1975 and 1976 model-year, consumer-owned, catalyst-equipped vehicles in California were tested to measure the regulated exhaust gas emissions and particulate sulfate emissions. Each vehicle was tested three times over a period of approximately 11 months. All tests were conducted with the owner's brand of commercial fuel which was analyzed for sulfur and lead concentrations, Reid vapor pressure, distillation and API gravity. Emission data were analyzed to determine if there were any significant differences in sulfate and regulated gaseous emission levels between various subgroups of catalyst-equipped vehicles, and to derive average emission factors for sulfate emissions.

39812 Immunological studies on platinum complexes and their possible relevance to autocatalysts. Cleare, M.J. Warrendale, PA; Society of Automotive Engineers (1977). 13p. (CONF-770205—72).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Preliminary tests on extracts from exhaust solids support the hypothesis, deduced from tests on refinery workers and estimates of the types of Pt compounds likely to be formed, that no allergenic species are emitted. A series of Pt complexes has been used for allergy tests on a number of refinery workers who are known to be sensitive to hexachloroplatinate $[PtCl_6]^{2-}$ salts. The results show that the allergy-eliciting compounds appear to be confined to a very small group of ionic complexes containing reactive halogen ligands. Neutral complexes and those containing strongly bound groups are totally inactive. These variations are discussed in terms of established kinetic and thermodynamic parameters and their relevance to autocatalysts.

39813 Anti-pollution device. Gagliardi, J.F. (to Did-Mor Engineering and Manufacturing Co.). US Patent 4,011,846. 15 Mar 1977. Filed date 24 Mar 1975. 6p.

A method is disclosed for controlling pollution emission of an internal combustion engine which includes the steps of mixing gases exhausted from the engine combustion chambers with gases exhausted from the engine crankcase and then directing the mixed gases back to the combustion chambers. For practicing the method a pollution control device is also disclosed which included means for receiving and mixing together gases from an engine exhaust manifold and crankcase, and means for directing the mixed gases to engine combustion chambers.

39814 Annular piston engine with afterburner and power turbine. Bachmann, W.V. US Patent 4,011,725. 15 Mar 1977. Filed date 19 May 1975. 22p.

An internal combustion engine includes an annular or ring-type cylinder and piston therein. Exhaust ports from the cylinder lead to an afterburner reactor situated generally medially of the annular cylinder. The exhaust gases are further burned within the

afterburner section; to further reduce pollutants during the afterburning process, additional air is pumped into the afterburner section as by the ring piston due to its special configuration. Further, to extract a considerable amount of energy from the waste exhaust gases leaving the afterburner, a power turbine is provided which is within the exit path of the exhaust gases. The power turbine is conveniently incorporated as into the engine head and the turbine output shaft is either geared by reduction gear means to work in unison with the output crank shaft, or the turbine shaft rotates at an independent speed and is geared to drive (some or all of) the engine and/or vehicular accessories.

NITROGEN OXIDES

REFER ALSO TO CITATION(S) 39761, 39762, 39764, 39765, 39768, 39770, 39773, 39795, 39801, 39804, 39826, 39837

39815 Environmental-energy policies and automotive pollution. Cesario, F.J. (Cornell Univ., Ithaca, NY). *J. Environ. Syst.;* 5: No. 1, 13-28(1975).

After delineating the areas of potential conflict between environmental conservation and energy conservation policies, the air quality implications of alternative environmental/energy policy scenarios are examined with particular reference to five urban regions of New York State. In this analysis it is presumed that energy conservation policies will serve to limit the amount of fuels available for private transportation, while the environmental policies considered are those that serve to roll back Clean Air Act air quality standards beyond 1976. It is shown that due to the interdependent nature of environmental and energy conservation objectives, policies in these two areas of concern should be developed conjointly.

39816 Torque measurements and mechanized driver for correlating exhaust emission test facilities. Klingenberg, H.; Kinne, D.; Schuermann, D. Warrendale, PA; Society of Automotive Engineers (1977). 10p. (CONF-770205—18).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Investigations showed that the current calibration procedures for dynamometers do not suffice to obtain a good conformity between different dynamometers. As a criterion for dynamometer calibration, we use in two different ways the torque which is measured on the drive shaft of a test car. The static method yields the complete dynamometer characteristic: torque versus car speed. The dynamic method uses the averaged time integral of the torque measured over a driving cycle. Both methods supplement each other. In order to achieve a good reproducibility, a mechanized driver has been developed. Test results are discussed.

39817 Quality control technique for correlating exhaust gas analysis systems. Paulsell, C.D.; Keller, J. Warrendale, PA; Society of Automotive Engineers (1977). 17p. (CONF-770205—19).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

A simple, inexpensive, critical flow blender was developed for filling a tedlar bag with controllable concentrations of HC, NOx, CO_2, and CO gases at levels encountered in automobile emissions testing. According to a daily schedule, a technician takes the bag to all analyzer sites in the laboratory for analysis. The concentrations indicated by each site are compared to the overall averages. The results are stored in a computerized data base from which control charts, statistical analyses, and interpretations of significant differences among test sites can be made. the precision, accuracy, and statistical interpretations of the data are discussed.

39818 Comparison and optimization of exhaust emission test procedures. Klingenberg, H.; Kuhler, M.; Lies, K.H.; Pazsitka, L.; Schuermann, D. Warrendale, PA; Society of Automotive Engineers (1977). 10p. (CONF-770205—20).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Distribution functions of repetitive exhaust measurement results on the same vehicles and of single measurement results on many vehicles from the assembly line are investigated. The correlation between mass emission components is also analyzed. The probabilities for passing or failing certification tests are calculated using a Monte Carlo method under consideration of the standard deviations of test data. From the results of these statistical and experimental investigations, proposals for the improvement of certification- and assembly line test procedures for the USA and Europe are deduced.

39819 Dynamometer test procedures for three-way catalyst screening. Heyde, M.E.; Adawi, M.K.; Anderson, D.H.; Schroeder, M.P.; DeLosh, R.G. Warrendale, PA; Society of Automotive Engineers (1977). 7p. (CONF-770205—22).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Procedures are described for rapidly aging and for testing three-way catalysts on an engine dynamometer which are relatable to actual vehicle aging and CVS testing. The accelerated aging cycle consists of a modification of the AMA durability driving cycle; testing consists of the measurement of HC, CO and NOx conversion as a function of A/F with superimposed perturbations which simulate limit cycle variations of A/F in a closed-loop fuel control system.

39820 Exhaust emission control of S.I. engines by engine modification: the SEEC-T system. Fukushima, T.; Nakamura, H.; Sakai, T. Warrendale, PA; Society of Automotive Engineers (1977). 14p. (CONF-770205—5).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The recently developed SEEC-T (Subaru Exhaust Emission Control—Thermal and Thermodynamic Control) system meets the 1977 emission standards of the United States including California and the 1976 standards of Japan without catalytic converters or thermal reactors and will satisfy the more stringent emission standards expected in the future. The SEEC-T system reduces HC, CO and NO/sub x/ by the following three means. First, air fuel ratio is set leaner than stoichiometric by improvements in the carburetor. Combustion gas temperature is controlled by EGR and ignition timing control. Introduction of secondary air into the cylinder by backflow from the exhaust port improves combustion at light load driving. These means reduce the three emission components within the cylinder. Second, exhaust port liners inserted in a Siamese type exhaust port reduce HC and CO discharged from cylinders by holding the exhaust gas at higher temperatures. Third, insulated exhaust manifold helps to lower residual HC and CO. A description is given of the following four aspects of the SEEC-T system: (1) structure of the SEEC-T system; (2) suppression and reduction of HC and CO; (3) effect of NO/sub x/ control on driveability, combustion stability and fuel economy; and (4) improvement in combustion by introduction of secondary air.

39821 Exhaust emission levels of in-use 1975 and 1976 California automobiles. Appleby, M.R.; Bintz, L.J.; Tappenden, T.A. Warrendale, PA; Society of Automotive Engineers (1977). 7p. (CONF-770205—8).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Exhaust emission data for 1975 and 1976 California automobiles were generated, using the Federal Test Procedure, at the time of their delivery and after the vehicle engines had matured. The emission test results indicate the degree of emissions control achieved compared to pre-1966 uncontrolled automobiles. Also differences between green and mature engines and the statistical differences in the test data are described. Conclusions discuss statistical trends of the results and how the data relates to current and possible future vehicle emissions, ambient air quality reductions, and other related trade-off factors.

39822 Characterization of multifunctional catalysts for automotive exhaust purification. Koberstein, E. Warrendale, PA; Society of Automotive Engineers (1977). 12p. (CONF-770205—24).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The basic working principles and the different types of multifunctional catalysts for "three way systems" are reviewed. Test methods for multifunctional catalysts characterizing activity and stability are described. Aging procedures in air may cause problems with rhodium containing multifunctional catalysts. Different surface oxidation states of rhodium depending on pretreatment conditions were detected in multifunctional catalysts. The influence of those oxidation states on activity is discussed.

39823 Treatise on exhaust emission test variability. Juneja, W.K.; Horchler, D.D.; Haskew, H.M. Warrendale, PA; Society of Automotive Engineers (1977). 25p. (CONF-770205—67).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The major sources of variability of an exhaust emission test on the 1975 Federal Test Procedure (FTP) are discussed. Vehicle, driver and the ambient conditions affect hydrocarbon (HC) and carbon monoxide (CO) variability significantly. On the other hand, oxides of nitrogen (NO/sub x/) and carbon dioxide (CO_2) are influenced more by the differences in vehicle loading. However, the importance of any other source of variability cannot be ignored, especially when a comparison is made between two tests. Various diagnostic aids, such as the "Total Torque Tester", a "Driver

Evaluator", an "Exhaust Bag Cross-Check", and a "Repeatable Car", which are used for the purpose of a better correlation between measurement systems on different test sites, are described. Designed experiments were conducted on vehicles whose emission levels were at or near the standards of 0.41 grams per mile HC, 3.4 grams per mile CO and 2.0 grams per mile NO/sub x/. A computer simulation of emissions was also employed to determine relative contributions from different sources to overall variability. Variability due to measurement error and within—vehicle variability observed in this work is +-19 percent of the mean for HC, +-33 percent of the mean for CO, +-9 percent of the mean for NO/sub x/ and +-5 percent for the mean for CO_2. Variability as used here is defined as 1.96 times the coefficient of variation. The magnitude of variability is variable depending on differences in the overall system which includes the vehicle, the measurement system and test operating conditions.

39824 Exhaust gas cleaning apparatus for an internal combustion engine for a vehicle. Suziki, K.; Kawatake, K.; Sawada, H.; Matsuoka, H. (to Tyota Jidosha Kogyo Kabushiki Kaisha). US Patent 4,010,723. 8 Mar 1977. Priority date 15 Oct 1975, Japan. 6p.

An exhaust gas cleaning apparatus is described for an internal combustion engine for a vehicle having a carburetor including an air bleed system to bleed air into a fuel line of the carburetor. An exhaust gas recirculation valve with a diaphragm mechanism is controlled by negative pressure in the carburetor to recirculate a part of the exhaust gas from the exhaust manifold to the intake manifold. The apparatus comprises another air bleed system to bleed air to the fuel line of the carburetor and valve means for communicating the other air bleed system and the diaphragm mechanism of the exhaust gas recirculation valve with the atmosphere in response to negative pressure in the venturi of the carburetor and in the intake manifold.

39825 Internal combustion engine operation utilizing exhaust gas recirculation. Mayer, E.A.; Plungis, D.W. (to Texaco Inc.). US Patent 4,011,845. 15 Mar 1977. Filed date 17 Dec 1974. 6p.

The invention described relates to a method and apparatus for reducing the amount of undesirable products of combustion which are discharged to the atmosphere from an internal combustion engine during operation of the latter. The apparatus comprises, means for segregating a portion of an exhaust gas stream from the engine's exhaust discharge manifold or valve. The hot exhaust gas segment is cooled, combined with air to form a preliminary mixture, and delivered to the engine's combustion chambers. A predetermined volume of fuel is injected into the combustion chamber whereby to intermix with a portion of the preliminary mixture in such a manner that at least a part of the latter becomes combustible. The apparatus for achieving the method comprises means for recycling said segment of said hot exhaust gas. It further comprises means for controllably regulating the flow of the latter in response to the load variations imposed on the engine.

CARBON MONOXIDE

REFER ALSO TO CITATION(S) 39762, 39764, 39768, 39770, 39773, 39801, 39815, 39816, 39817, 39818, 39819, 39820, 39821, 39822, 39823

39826 Time resolved measurements of the exhaust from a jet ignition preclamber stratified charge engine. Ekchian, A.; Heywood, J.B.; Rife, J.M. Warrendale, PA; Society of Automotive Engineers (1977). 20p. (CONF-770205—74).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

In the jet-ignition prechamber stratified-charge spark-ignition engine, the fuel-air mixture at the time of combustion is non-uniform. Instantaneous exhaust mass flow rates and emission concentrations from this engine were measured and used to determine the degree to which this charge stratification persists in the products of combustion immediately downstream of the exhaust valve throughout the exhaust process. In all the cases studied no appreciable variations, during the exhaust process, were detected either in the air-fuel ratio of the exhaust gases as a function of time or in the instantaneous concentrations of CO_2, O_2 and NO/sub x/. The experimentally obtained instantaneous HC and CO concentrations in the exhaust, however, displayed large fluctuations and were used to study the sources of these two pollutants in this engine.

SULFUR DIOXIDE

39827 Diesel car emissions: emphasis on particulate and sulfate. Springer, K.J.; Stahman, R.C. Warrendale, PA; Society of Automotive Engineers (1977). 30p. (CONF-770205—3).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Diesel-powered cars afford some distinct advantages in fuel economy and certain exhaust emissions relative to the conventional Otto cycle engine. Particulate and sulfate emissions from light-duty diesels are two important unregulated emissions for which little is known. Five diesel-powered, light-duty vehicles, a Peugeot 204D, a Mercedes 240D, a Mercedes 300D, a Comprex-equipped Mercedes 220D, and a Perkins 6-247 powered IH pickup, were used to quantify the range of particulate, sulfate as well as other unregulated emissions of odor, visible smoke, sulfur dioxide, aldehydes, and selected non-reactive hydrocarbons. Three transient driving cycles were employed including that used in emissions certification, sulfate testing, and highway fuel economy. Emission rates of particulate, sulfate, and other contaminants of a regulated and unregulated nature are presented in several ways: mass per unit of time, per unit of fuel consumed, and per unit of distance driven. Fuel consumption and economy values are also provided.

39828 Effects of engine parameters and catalyst composition on vehicle sulfate emissions. McKee, D.E. Warrendale, PA; Society of Automotive Engineers (1977). 10p. (CONF-770205—10).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Sulfate emissions from two oxidation catalyst-equipped, 400 CID vehicles were measured using a dilution tube. The effects of spark timing, exhaust gas recirculation (EGR), oxygen concentration, and catalyst composition were studied. The vehicles were identical Ford LTD's; one was calibrated for 1976 Federal emission standards, the other for the stricter 1976 California standards. At steady-speed 72 km/hr (45 mph), the conversion of SO_2 to SO_3 over Engelhard IIB catalysts as a function of oxygen concentration is similar to that observed in laboratory studies; a dramatic reduction in sulfate emissions occurs at less than 1 percent O_2. On the EPA Congested Freeway Driving Schedule (CFDS), the sulfate emission level is considerably lower than on the 72 kph cruise, and no sharp reduction at low average oxygen concentrations is seen. Three different noble-metal catalyst formulations were studied: platinum/palladium, platinum/rhodium, and pure palladium. Under steady-speed operation of the Federal vehicle at 72 kph, the emission rates from the catalysts in the order listed above were 47, 17, and 6 mg/km. Quite different results were obtained from the CFDS: for all the catalysts, the emission rates were 4 to 7 mg/km on the Federal vehicle and 16 to 28 mg/km on the California vehicle. The mitigation of the differences between catalysts indicates that under realistic driving conditions, the noble-metal catalyst composition may be unimportant in determining sulfate emissions.

39829 Automotive sulfate emissions: a baseline study. Somers, J.H.; Garbe, R.J.; Lawrence, R.D.; Baines, T.M. Warrendale, PA; Society of Automotive Engineers (1977). 17p. (CONF-770205—11).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

A baseline testing program was designed and implemented by EPA wherein 78 vehicles were tested in 5 laboratories. The objectives of this study were to (1) obtain sulfate emission factors on a wide variety of different in-use vehicles using current and advanced emission control methods, and (2) determine the effect on sulfate emissions of vehicles meeting increasingly stringent gaseous emissions standards. The program was designed such that the vehicles were divided into the following classes: (1) production non-catalyst vehicles, (2) production catalyst vehicles—grouped according to emissions standards, (3) advanced non-catalyst vehicles, (4) advanced catalyst vehicles, and (5) fleet vehicles.

39830 Sulfate analysis by the barium perchlorate titration and the BCA methods. Prostak, A. Warrendale, PA; Society of Automotive Engineers (1977). 7p. (CONF-770205—45).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The barium ion titration method as used for determining the amount of sulfuric acid and soluble sulfate aerosol emitted by automobiles is described. Results obtained by this method are compared with those obtained by the barium chloranilate (BCA) method. It is concluded that the described titration method is a low-cost and convenient method for the analysis of automotive derived sulfates. Its precision is good, its sensitivity is adequate, and its accuracy is as good as the BCA method.

HYDROCARBONS

REFER ALSO TO CITATION(S) 39761, 39762, 39764, 39765, 39768, 39770, 39773, 39795, 39801, 39815, 39817, 39818, 39819, 39820, 39821, 39822, 39823, 39826

39831 Automotive hydrocarbon emission patterns in the measurement of nonmethane hydrocarbon emission rates. Black, F.; High, L.

Warrendale, PA; Society of Automotive Engineers (1977). 17p. (CONF-770205—15).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The advent of emission control technology has resulted in significant changes in both the total mass and detailed patterns of hydrocarbons emitted from automobiles. Emission rates of 56 hydrocarbons from 22 motor vehicles, including catalyst and noncatalyst configurations, were determined for the Federal Urban Driving Cycle. An increased relative abundance of methane is indicated for vehicles equipped with oxidation catalysts. In view of the photochemically non-reactive nature of methane, simple and economic procedures for determination of vehicle nonmethane hydrocarbon emission rates are evaluated. In general the procedures evaluated require independent total hydrocarbon and methane analysis, with the nonmethane hydrocarbon level calculated by difference. The procedures are evaluated by comparison of indicated nonmethane hydrocarbon emission rates with rates obtained by summation of individual compound rates determined by advanced gas chromatographic procedures.

39832 Analyzers for methane in exhaust gas. Prostak, A.; Reschke, G.D. Warrendale, PA; Society of Automotive Engineers (1977). 8p. (CONF-770205—16).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

A gas chromatographic instrument was developed to measure methane in diluted automotive exhaust. Measurements can be made on a 60-second cycle with a standard deviation of 0.06 ppM methane and with no known interferences. In addition, a prototype selective combustor for continuous methane determination in exhaust was evaluated and found to be satisfactory.

39833 Optimization of a flame ionization detector for determination of hydrocarbon in diluted automotive exhausts. Reschke, G.D. Warrendale, PA; Society of Automotive Engineers (1977). 23p. (CONF-770205—17).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The effects of burner flow parameters, fuel type, and fuel composition on the uniformity of relative response of a Flame Ionization Detector (FID) hydrocarbon analyzer were experimentally investigated. Means have been found to improve correlation between analyzers and to optimize relative response characteristics. Although this investigation was directed at analyzers being used for analysis of dilute exhaust sample bags from the Federal Vehicle Emission Test, the results can be applied to a FID in other applications.

39834 Origins of hydrocarbon emissions from diesel engines. Greeves, G.; Khan, I.M.; Wang, C.H.T.; Fenne, I. Warrendale, PA; Society of Automotive Engineers (1977). 18p. (CONF-770205—41).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Experimental data on the concentration of hydrocarbons (HC) emitted in the exhaust are presented for both direct injection (DI) and indirect injection (IDI) engines and cover the effect of a wide range of engine operating parameters. The analysis shows that there are two main sources of HC in DI engines. One is due to the volume of fuel in the sac and holes of the injection nozzle and the other is from fuel premixed to leaner than lean limit conditions. Reduction of sac volume and reduction of ignition delay are effective in reducing the HC from the sac volume and lean limit sources, respectively. Developments in fuel injection equipment and engine design to reduce HC emissions are outlined.

PARTICULATES

39835 Evaluation of sulfate trapping candidates: results from dynamometer and vehicle screening tests. Barnes, G.J.; Summers, J.C.; Fredericks, D.R. Warrendale, PA; Society of Automotive Engineers (1977). 12p. (CONF-770205—71).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The performance of potential sulfate sorbents was evaluated using an engine-dynamometer screening test procedure. Bulk and supported sorbents were tested. The two most promising sorbents were a bulk CaO preparation and alumina supported Na. The CaO sorbent appeared to be inherently non-selective between sulfates and SO_2. Calcining this sorbent in a CO_2 atmosphere resulted in increased pellet crush strength and reduced volume expansion upon use. The Na/Al_2O_3 sorbent had good activity and selectivity, but may lack capacity and be subject to leaching losses of Na-compounds. Vehicle and dynamometer durability testing of these two sorbents was conducted. From these preliminary tests, it was determined that neither met all the criteria of an ideal sorbent for vehicle use.

39836 Trapping of lead particulates in automotive exhaust. Treuhaft, M.B.; Wisnewski, J.P. Warrendale, PA; Society of Automotive Engineers (1977). 21p. (CONF-770205—73).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Systems for controlling automotive exhaust particulates, especially lead particulates, are discussed and a suitable method for determining automotive particulate emission levels during on-the-road vehicle operation are presented. Data are presented for a large number of vehicles. The evaluation system is suited for use with a large variety of vehicles during all modes of vehicle operation. A total emissions control system, capable of meeting the strict 1978 statutory gaseous emissions levels with virtually zero particulate emissions, is also discussed. This emissions control system is compatible with leaded and unleaded fuels. The economic implications of lead additive restriction, as a means of reducing lead airborne particulates, are briefly considered. It is concluded that the reduction of airborne lead, by trapping it in the exhaust system, is more cost effective and energy conservative than is reduction by regulation of the fuel supply. Particulate traps coupled with lead-tolerant emission control systems allow this alternative.

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 39382, 39383, 39808

39837 (BNL—22444) Formation of NO and NO_2 in the I.C. engine combustion of methyl alcohol and fuel-nitrogen doped methyl alcohol. Prasad, C.R.; Davis, R.E.; Klemm, R.B.; Brateman, J.M. (Brookhaven National Lab., Upton, N.Y. (USA)). Jan 1977. Contract EY-76-C-02-0016. 15p. P 02/MF A01.

Measurements of NO/sub x/ levels in the exhaust gas from a CFR engine fueled with methyl alcohol are reported. The results showed that the dominant form of NO/sub x/ for lean combustion conditions was NO_2. The significance of this observation is discussed. Also, the conversion to NO/sub x/ of several added "fuel-nitrogen" compounds was studied. The data for the conversion of pyridine, di-ethylamine, and acetonitrile added to methyl alcohol were qualitatively similar showing equal to or greater than 50 percent conversion for lean operation but less than 50 percent conversion for rich operation.

39838 (DLR-FB—76-18) Propellant selection for ramjets with solid fuel. Schmucker, R.H.; Lips, H. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Lampoldshausen (Germany, F.R.). Inst. fuer Chemische Raketenantriebe). 11 Mar 1976. 33p. (In German). Dep. NTIS (US Sales Only) $4.00.

Ramjet propulsion using solid propellant for post-boost acceleration of missiles exhibits several favorable properties, brought about by heterogeneous combustion. A simplified theory for calculating the performance of possible propellants is presented, and they are classified with respect to maximum fuel-specific impulse. The optimal choice of fuel, from a system standpoint, must consider volume constraints, and defines the requirements for motor geometry.

39839 Model of the automobile industry implementation of more fuel-efficient technologies. Cooper, K. (Pugh-Roberts Associates, Inc., Cambridge, MA); Pugh, A.L. III; Lyneis, J.; Frasier, C.; Phillips, C.; Vance, L. pp 618-623 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

In the past five years, the automobile industry has been forced to deal with a severe economic recession, the "energy shortage" and the attendant fuel price escalation, radical shifts in consumer preferences for automobiles, and a proliferation of federal regulations on automobiles. In response to these conditions, a central set of decisions on the part of manufacturers has involved the implementation of more fuel-efficient technologies. A model to examine the response of automobile manufacturers to changing economic conditions and to alternative federal regulations was designed. In doing so, the modeling effort has focused upon government regulations and manufacturer decisions regarding the fuel efficiency of new cars. This work was sponsored by the Department of Transportation.

39840 Engine failure and high speed knock. Cornetti, G.M.; De Cristofaro, F.; Gozzelino, R. Warrendale, PA; Society of Automotive Engineers (1977). 12p. (CONF-770205—12).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

High speed knock is one of the major obstacles to higher compression ratios and, consequently, lower fuel consumption. The relationship between engine failure and knock intensity was studied by testing a European engine at 4,000 and 5,000 rpm, on full throttle. Endurance test results show that the knock intensity which causes damage decreases as speed or combustion chamber temperature is increased. Other information obtained through analysis of the type of engine failure has suggested a way to increase compression ratio without changing octane requirement.

39841 Octane number requirement survey: 1959—1975 Japanese model passenger cars. Nakajima, K. Warrendale, PA; Society of Automotive Engineers (1977). 12p. (CONF-770205—13).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

The results of annual surveys for octane number requirements of Japanese model passenger cars during 1959 to 1975 showed that the octane number (ON) required to satisfy 50 percent and 90 percent in 1972 model cars increased to 91.8 and 98.5, but after that octane number requirements steadily decreased, then 1975 model cars required 89.4 and 93.5 ON at 50 percent and 90 percent car satisfaction level. About 90 percent of the cars tested obtained maximum octane number requirement at wide open throttle. High speed octane number requirements (80 to 120 km/hr) of 1975 model cars at 50 percent and 90 percent car satisfaction were 85.9 and 90.2 ON.

39842 Use of gas engines for motor vehicles in oil exporting countries. Rashidi, M.; Massoudi, M.S. Warrendale, PA; Society of Automotive Engineers (1977). 8p. (CONF-770205—14).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Natural gas is a valuable commodity produced as a by-product of oil drilling in many parts of the world. Using this commodity essentially requires that problems associated with its low specific gravity be overcome. One possible application is for vehicular propulsion in localities close to the gas deposit. The major advantages and disadvantages of this course of action are reviewed.

MATERIALS

39843 Self-supporting thin films: parting agent. Arakawa, E.T.; Chung, M.S.; Williams, M.W. (Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Rev. Sci. Instrum.;* **48**: No. 6, 707-708(Jun 1977).

To produce self-supporting thin films a substrate must be coated with a parting agent before the sample material is vacuum deposited on the substrate. We describe a spin-coating method which is simpler, faster, and more reliable than our previous methods of applying the parting agent.

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 39169, 40053

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 39869, 39980, 40006

39844 (CONF-7609101—1) **Effects of microstructure on ultrasonic examination of stainless steel.** Kupperman, D.S.; Reimann, K.J. (Argonne National Lab., Ill. (USA)). 1976. Contract W-7405-ENG-38. 24p. Dep. NTIS $3.50.

From Specialist meeting on ultrasonic inspection of reactor components; Risley, United Kingdom of Great Britain and Northern Ireland (UK) (27 Sep 1976).

Ultrasonic inspection of cast stainless steel components or stainless steel welds is difficult, and the results obtained are hard to interpret. The present study describes the effects of stainless steel microstructure on ultrasonic test results. Welded coupons, 2.5 and 5.0 cm thick, were fabricated from Type 304 stainless steel, with Type 308 stainless steel as the weld material. Metallography of the base material shows grain sizes of 15 and 80 μm, and dendrites aligned from the top to the bottom surface in cast material. X-ray diffraction and ultrasonic velocity measurements indicate a random crystal orientation in the base material, but the cast sample had aligned dendrites. The weld material exhibits a dendritic structure with a preferred (100) direction perpendicular to the weld pass. Spectral analysis of ultrasonic broad-band signals through the base materials shows drastic attenuation of higher frequencies with increasing grain size (Rayleigh scattering). Annealing and recrystallization increases the ultrasonic attenuation and produces carbide precipitation at grain boundaries. The microstructural differences of the base metal, heat-affected zone, and weld metal affect the amplitude of ultrasonic reflections from artificial flaws in these zones. Data obtained from two samples of different grain sizes indicate that grain size has little effect when a 1-MHz transducer is used. When going from a 15 to an 80-μm crystalline structure, a 5-MHz unit suffers a 30-dB attenuation in the detection of a 1.2 mm deep notch. The anisotropy of the dendritic structure in stainless steel renewed the interest in the effect of shear-wave polarization. In the (110) crystallographic orientation of stainless steel, two modes of shear waves can be generated, which have velocities differing by a factor of two. This effect may be helpful in "tuning" of shear waves by polarization to obtain better penetration in large grain materials such as welds.

39845 (ORNL—5145) **Structure and elevated temperature properties of type 308 stainless steel weld metal with varying ferrite contents.** Berggren, R.G.; Cole, N.C.; Goodwin, G.M.; Stiegler, J.O.; Slaughter, G.M.; Gray, R.J.; King, R.T. (Oak Ridge National Lab., Tenn. (USA)). Feb 1977. Contract W-7405-ENG-26. 22p. AT.

The as-deposited microstructure, creep and tensile properties at 649°C, and fracture behavior of shielded metal-arc type 308 stainless steel welds having nominal ferrite contents from 0 to 15 percent were investigated. The ferrite phase morphology varied from isolated patches in nominally 0 percent ferrite welds to a nearly continuous phase in nominally 15 percent ferrite welds metallographically proven. Low-ductility creep failures occurred when extensive interphase cracking occurred at austenite-sigma phase boundaries (i.e., for welds with high initial ferrite content tested under low stress). The fraction of creep test time before third-stage creep was usually less than 0.3 for specimens that exhibited high ductility.

39846 (ORNL—5243) **Liquid Metal Fast Breeder Reactor materials development program. Quarterly progress report for period ending September 30, 1976.** Peterson, S. (comp. and ed.). (Oak Ridge National Lab., Tenn. (USA)). Jan 1977. Contract W-7405-ENG-26. 294p. AT.

Research is summarized on steam generator materials development for the Clinch River Breeder Reactor plant, alternate LMFBR structural materials, the mechanical and metallurgical behavior of weldments for LMFBR, large-diameter piping and fitting development, and advanced absorber materials. (JFP)

39847 Mechanism of solid state pressure welding. Mohamed, H.A.; Washburn, J. (Univ. of California, Berkeley). *Weld. J. (Miami);* vp(Sep 1975).

The mechanism of pressure welding in polycrystalline aluminum, copper, silver, and gold was investigated. The role of the oxide film was studied, and it was found that no metal to oxide bonding contributes to the strength of the weld. From scanning electron microscope observations a two-stage model was suggested which could explain the different behavior of the metals studied. The first stage of welding involves the formation of overlapped oxide-free metallic areas; this is controlled by difference on a microscale of the local plastic strain occurring on matching opposite faces of the weld interface, relative hardness of the metal and its oxide film, and mechanical properties of the oxide. The second stage involves plastic flow of the metal to the over-lapped areas—the stress at which this can take place is influenced by the stacking fault energy of the metal—and some relative shear displacement at the points where metal cleaned of oxide comes into contact—this is influenced by surface roughness. The different weldability of different metals is attributed to differences in stacking fault energy, hardness ratio, and plastic properties of the oxide. The weld strength calculated theoretically on the basis of measured welded area was in agreement with measured fracture strength. It was concluded that the strength attained after a given deformation is determined by the fractional welded area at that deformation. 19 figures, 3 tables.

39848 Incoloy 800 for sodium-cooled fast reactor steam generators. Julien, M. (Fives-Cail-Babcock, 75 - Paris (France)). pp 535-554 of In 18. Colloque de metallurgie. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1976). (In French)

From 18. Colloquium on metallurgy. Ni and its specific properties in certain types of alloys; Saclay, France (23 Jun 1975).

The criteria governing the choice of materials for the steam generators of sodium-cooled fast reactors concern: the mechanical properties at high temperatures, creep resistance and ductility at these temperatures and their variation with structural changes in the alloy; the possibilities of making and welding the various components (tubes, plates); corrosion resistance under normal conditions (clean water, steam and sodium) or in the event of accident (polluted media). Incoloy 800 has already been used to build prototypes including one of 45 MWth, installed on the Renardieres C.G.V.S.-E.D.F. Station. These prototypes, built with industrial products,

have given satisfactory results after several thousand running hours. Research undertaken in particular by the Fives-Cail-Babcock Company and within the E.D.F./C.E.A. work program on fast reactor materials has led to recommended chemical composition and heat treatment limits and a manufacturing range giving optimum mechanical properties in service. The chemical composition chosen, the mechanical characteristics at room and high temperatures and results of welding and shaping experiments and of corrosion tests in various polluted media are presented.

39849 (N—76-29591) **Evaluation of a method to shield a welding electron beam from magnetic interference.** Wall, W.A. (National Aeronautics and Space Administration, Huntsville, Ala. (USA). George C. Marshall Space Flight Center). Aug 1976. 17p. (NASA-TM-X—73324). NTIS $3.50.

It is known that electron beams are easily deflected by magnetic and electrostatic fields. Therefore, to prevent weld defects, stray electromagnetic fields are avoided in electron beam welding chambers if at all possible. The successful results of tests conducted at MSFC to evaluate a simple magnetic shield made from steel tubing are reported. Tests indicate that this shield was up to 85 percent effective in reducing magnetic effects on the electron beam of a welding machine. In addition, residual magnetic fields within the shield were so nearly uniform that the net effect on the beam alignment was negligible. It is concluded that the shield, with the addition of a tungsten liner, could be used in production welding. (Author) (GRA)

39850 **Method for making high ductility beryllium bodies.** Webster, D.; Vidoz, A.E. (to Lockheed Missiles and Space Co., Inc.). US Patent 3,999,986. 28 Dec 1976. Filed date 8 Apr 1974. 6p.

A method for making high-ductility beryllium bodies by controlling beryllium oxide particle growth during hot pressing of beryllium powder to a maximum median size of 150 nm is described. More particularly, particle size is controlled by utilizing starting beryllium powder containing a maximum total concentration of aluminum, silicon and magnesium of 200 ppM and consolidating the powder at a maximum temperature of 1400°F. Ductility is also enhanced by utilizing starting beryllium powder containing a maximum beryllium oxide volume fraction of 1.6 percent and annealing the consolidated powder at temperatures of from 2000° to 2250°F. The anneal can be a separate operation or a continuation of the hot pressing operation. 7 figures, 1 table.

39851 **Process for producing ductile superconductive alloys.** Winter, H. (to Battelle-Institut eV). US Patent 4,000,014. 28 Dec 1976. Priority date 21 Sep 1973, German, Federal Republic of (F.R. Germany). 6p.

A process is described for incorporating a superconductive compound or compounds by fusion into a base metal having good electrical and heat conductive properties, such as copper, silver, aluminum, and the like. The process involves preparing a melt of the base metal and of the alloy components which combine to form the superconductive compound or compounds having a β-W (A15) structure. Then the melt is solidified at a cooling rate of at least 1000°C/s, whereby a ductile superconductive alloy is formed wherein the individual particles of the superconductive compounds are finely distributed in the base metal and are mutually spaced with respect to each other in such a way that the critical value for the tunnel effect is not exceeded. 12 claims.

39852 **Method of treating Zr-base alloys to improve post irradiation ductility.** MacEwen, S.R.; Simpson, C.J. (to Atomic Energy of Canada Ltd.). US Patent 4,000,013. 28 Dec 1976. Priority date 12 Jul 1974, Canada. 6p.

A zirconium-base alloy is produced, having improved ductility after irradiation with fast neutrons, by heating in a protective atmosphere a zirconium-base alloy containing precipitates in the form of at least one alloying element (e.g., Nb, Mo, Ni or Cr) which is soluble with the zirconium in the β phase and insoluble therewith in the α phase until the precipitates have dissolved, water quenching the zirconium-base alloy to produce a fine martensitic structure supersaturated with the or each alloying element, working the zirconium-base alloy in steps reducing the cross-sectional area 10 percent to 20 percent of the original cross-section (with annealing below recrystallization temperature for at least 10 minutes in the α phase between steps) until a total reduction of 70 percent to 75 percent of the original cross section is achieved, and then annealing the zirconium-base alloy so that simultaneous recrystallization and precipitation of the or each alloying element occurs. An alloy is produced having an average grain diameter of 0.1 to 0.5 microns which is particularly useful for nuclear fuel sheathing. An example of the procedure for a zirconium-base niobium alloy is given. 3 figures, 1 table.

STRUCTURE AND PHASE STUDIES

39853 (COO—2305-4) **Electron-dislocation interaction at low temperatures. Progress report.** (Connecticut Univ., Storrs (USA)). 1976. Contract EY-76-S-02-2305. 19p. Dep. NTIS $3.50.

Studies of the interaction of mobile dislocations with electrons have shown that dislocation motion can be, in part, described by treating the dislocation as an underdamped oscillator. In particular, studies in lead alloys have shown tht dislocation motion can be considered as the motion of string, slightly damped by electrons, without regard for any other lattice friction. In addition we have shown that silver solutes, in lead crystals, occupy, partially, interstitial sites. Finally, we have shown that dislocations in copper interact, unexpectedly, with electrons. This is shown by measuring the influence of a magnetic field on the flow stress of copper crystals at 4.2°K.

39854 (LBL—5103) **Deformation behaviour of Ti-50.3 at % Ni alloy.** Mohamed, H.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1976. Contract W-7405-ENG-48. 11p. (CONF-760804—7). Dep. NTIS $3.50.

From 4. international conference on strength of metals and alloys; Nancy, France (30 Aug 1976).

The early stage deformation behavior of Ti-50.3 at. percent Ni alloy was investigated. It was found that stress induced twin-boundary migration within existing martensite variants, migration of twin boundaries between twin-related adjacent martensite variants, reorientation of existing martensite by twinning on the most favorably oriented twin system, and additional transformation at the expense of retained high temperature phase.

39855 (ORNL—5222) **Product form characterization of type 304 stainless steel (HT 9T2796).** Swindeman, R.W.; McAfee, W.J.; Sikka, V.K.; McCoy, H.E. Jr.; Waddell, R.D. Jr. (Oak Ridge National Lab., Tenn. (USA)). Feb 1977. Contract W-7405-ENG-26. 136p. AT.

Characterization data are presented for 19 products of a large reference heat of type 304 stainless steel (heat 9T2796) being used to develop and verify inelastic design methods for liquid-metal fast breeder reactor components. Products include plate, pipes, and bars. The characterization data include chemical composition, grain size, hardness, tensile behavior at room temperature and at 593°C, and creep-rupture behavior at 593°C. The strength and ductility of a standard product (25-mm plate) are compared with the behavior of the other products, and it is observed that the material is fairly representative of the product average. Reasons for variability between the products are examined, and it is suggested that carbon content, nitrogen content, grain size, temperature control, and extensometer performance contribute to variability; the relative contribution from each source depends on the type of test.

39856 (ORO—5111-1) **Microstructural studies of hydrogen and deuterium in bcc refractory metals. Progress report.** Moss, S.C. (Houston Univ., Tex. (USA). Dept. of Physics). 1977. Contract EY-76-S-05-5111. 3p. P 02/MF A01.

The work has mainly involved the analysis of x-ray data, the preparation of single crystals of vanadium (V) and tantalum (Ta) for x-ray, neutron, and Compton experiments; the planning of a specific neutron experiment at Argonne on D-D correlations in V above its ordering temperature, the initiation of the Compton profile measurements in pure V, and the set-up and preparation of the x-ray diffraction equipment. (RWR)

39857 **Dislocation motion as an underdamped oscillator and electron—dislocation interactions in dilute lead solid solutions.** Tregilgas, J.H.; Galligan, J.M. (Univ. of Connecticut, Storrs). *Acta Metall.;* **24**: 1115-1120(1976).

The influence of both tin and silver on solid solution hardening and electron drag was studied in dilute lead alloys. Both the yield stress and electron drag in the lead—tin substitutional solid solutions were observed to be independent of concentration at low solute concentrations. In contrast to this, lead—silver alloys showed both a very pronounced hardening and a strong electron—dislocation interaction due to the presence of silver in interstitial lattice positions. In addition, the activation volume for dislocation motion was observed to be larger in the normal state than in the superconducting state. This finding is consistent with the inertial model of dislocation motion with dislocations moving as underdamped harmonic oscillators. 8 figures.

39858 **Structure and properties of a microduplex maraging steel.** Jin, S.; Huang, D.; Morris, J.W. Jr. (Univ. of California, Berkeley). *Metall. Trans., A;* **7A**: 637-645(May 1976).

A simple two-step thermal processing technique was devised to impart a microduplex structure in a high-strengtn 250-grade commercial maraging steel. A martensite grain size of approximately 1 μm was obtained with interspersed islands of retained austenite whose volume fraction and mechanical stability could be controlled by varying the thermal processing conditions. The microstructure and mechanical properties of the microduplex structure were compared to those of the alloy in the maraged, martensitic condition. Due to the presence of the austenite phase, the microduplex structure showed a much smaller temperature and strain rate dependence of deformation than the martensitic structure. A remarkable increase

in uniform elongation was observed below the M/sub d/ temperature of retained austenite. The microduplex structure did not show any significant advantage in fracture toughness over the martensitic structure when compared at similar strength levels. By suitably adjusting austenitic stability a deformation-induced phase transformation (TRIP) of the retained austenite in the microduplex structure could be made to occur; however, the transformation did not lead to any evident increase in toughness. The microduplex structure exhibited a slight improvement in fracture toughness at high strain rate, in contrast to the martensitic structure in which the rate effect significantly reduced the toughness. 10 figures, 3 tables.

39859 Secondary electron emission of single crystals of molybdenum—niobium alloys. Savitskii, E.M.; Burov, I.V.; Kapustin, V.I. (A. I. Baikov Institute of Metallurgy, Academy of Sciences of the USSR, Moscow). *Sov. Phys. - Dokl. (Engl. Transl.);* **21**: No. 11, 643-645(Nov 1976).

Employing primary electrons of 50-200 eV, the composition-property (maximum SEEC) diagrams in the solid solution region were studied for Mo-Nb.(AIP)

39860 Structure and properties of age hardened Cu—Ti alloys. Datta, A (Allegheny Ludlum Research Center, Brackenridge, PA); Soffa, W.A. *Acta Metall.;* **24**: No. 11, 987-1001(Nov 1976).

Electron microscopy and diffraction were employed to study the microstructural behavior of age hardening Cu—Ti alloys. Two alloys nominally containing 1 and 4 wt. % Ti were studied, and the electron metallography results were correlated with the mechanical properties. The microstructural behavior of these sideband alloys suggests that the characteristic modulated structures derive from metastable spinodal decomposition of a single phase into a disordered phase and an ordered phase. The clustering and ordering processes were analyzed by use of simple graphical thermodynamics. The mechanical hardening attendant to the formation of the modulated structures was analyzed quantitatively in terms of salient microstructural parameters by use of modern theories of strengthening. The age hardening response of the Cu—4 wt. % Ti alloy is substantially explained in terms of the interaction of dislocations with the internal stress field associated with the spinodal or modulated structures using Cahn's model of spinodal hardening. Overaging in the Cu—4 wt. % Ti alloy is observed to stem primarily from cellular or discontinuous precipitation occurring along the grain boundaries, and the full strengthening potential of the modulated structure is apparently not realized. 16 figures, 2 tables.

39861 Basal textures of the two grain size distributions in rolled ingot source beryllium with a duplex microstructure. Heiple, C.R. (Rockwell International, Golden, CO). *Metall. Trans., A;* **7A**: 1887-1889(Dec 1976).

A selective recrystallization model is proposed to explain the origin of the stronger basal texture in rolled powder source beryllium compared to rolled ingot source beryllium. In addition, the model predicts that the large grains in the duplex microstructure of rolled ingot source beryllium will have a stronger basal texture than the small grains. The orientations of the large and small grains in rolled ingot beryllium have been measured with polarized light. The average concentrations of basal poles lying within 20 deg of the sheet normal was 3.8 times random for the large grains and 2.1 times random for the small grains.

39862 Valence transformation of Eu atoms due to defect association in cold-worked EuMg alloys. Pirich, R.G.; Burr, C.R.; Shenoy, G.K.; Dunlap, B.D.; Suits, B.; Phillips, J.D. (State University of New York at Binghamton, Binghamton, New York 13901). *Phys. Rev. Lett.;* **38**: No. 20, 1142-1144(16 May 1977).

Magnetic susceptibility and Moessbauer-effect measurements on a series of dilute alloys of Eu in Mg have been performed. In strain-free samples the Eu ions are divalent, but in cold-worked samples a large fraction are converted to the trivalent state. Isochronal annealing studies suggest that this is related to the trapping of dislocation on impurity clusters with the valence change occurring because of the strain field of the dislocation.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 39507, 39508, 39509, 39513, 39572, 39573, 39845, 39846, 39848, 39852, 39855, 39858, 39860, 39888, 39908

39863 (ORNL—5073) **Time-dependent fatigue of structural alloys. A general assessment (1975).** Coffin, L.F. Jr.; Manson, S.S.; Carden, A.E.; Severud, L.K.; Greenstreet, W.L. (Oak Ridge National Lab., Tenn. (USA)). 10 Nov 1976. Contract W-7405-ENG-26. 441p. AT.

A review and assessment of time-dependent fatigue was needed to provide an understanding of time-dependent fatigue processes, to define the limits of our present knowledge, and to establish bases for the development of verified design methods for structural components and systems for operation at elevated temperatures. A review is given of the present state of understanding of that phenomenon, commonly called "creep fatigue," and separates it into crack-initiation and crack-propagation processes. Criteria for describing material behavior for each of these processes are discussed and described within the extent of present knowledge, which is limited largely to experience with one-dimensional loading. Behaviors of types 304 and 316 stainless steel are emphasized. Much of the treatment of time-dependent failure presented is new and of a developing nature; areas of agreement and areas requiring further resolution are enumerated. A list of questions formulated from the design point of view are addressed and answered insofar as possible from present assessment. Recommendations are given for near-term and long-term objectives for future research on time-dependent fatigue.

39864 Low cycle fatigue of austenitic alloys in hot water. Garnier, C.; Barrachin, B.; Roche, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). pp L6/7 1-8 of In Structural mechanics in reactor technology. Vol. 5. Jaeger, T.A. (comp.) (Bundesanstalt fuer Materialpruefung, Berlin (Germany, F.R.)). Amsterdam, The Netherlands; North-Holland (1975).

From 3. international conference on structural mechanics in reactor technology; London, UK (1 Sep 1975).

Low cycle fatigue analysis is a very important problem in structural mechanics. First of all, it is necessary to know the behavior of material in working conditions, under cyclic straining. Temperature and chemical composition of the fluid in contact must be included in these 'working conditions'. For water reactors, it is useful to have results obtained under the conditions of the primary circuit water. Most of the available results were obtained in air at room temperature, and their validity for applications are questionable. Tests were undertaken at Saclay in order to estimate the water composition and temperature effects. Tests are in progress on devices connected with the 'PRIMEAU' loop. This loop provides circulating water with the required conditions (pressure, temperature, chemical contents). Some indications are given on the main features of this loop, with special emphasis on the test sections. Each test section allows batches of four samples to be tested at a time. For calibration of the results, similar tests are carried out in air at room temperature on isolated test sections. Preliminary results show that low cycle fatigue resistance is affected by test conditions.

39865 Biaxial fatigue of mild steel; data compilation and analysis. Havard, D.G. (Ontario Hydro Research Lab., Toronto (Canada)); Williams, D.P.; Topper, T.H. (Waterloo Univ., Ontario (Canada)). pp L6/2 1-13 of In Structural mechanics in reactor technology. Vol. 5. Jaeger, T.A. (comp.) (Bundesanstalt fuer Materialpruefung, Berlin (Germany, F.R.)). Amsterdam, The Netherlands; North-Holland (1975).

From 3. international conference on structural mechanics in reactor technology; London, UK (1 Sep 1975).

Design of pressure vessels, including components of nuclear reactors, where loading varies periodically during service, requires an estimate of fatigue life for conditions of biaxial stress. The ASME pressure vessel code does this by the use of the maximum shear criterion, modified to include the strain dependence of fatigue behavior. However, since the ASME code was developed, a number of authors have reported biaxial fatigue data which are more accurately described by various other criteria. This study attempts to generate a relationship that describes a broad range of published biaxial fatigue data and to review the accuracy of the ASME code fatigue criterion. This paper describes a study of performed at the University of Waterloo which combined data from nine investigations of fatigue of mild steels at room temperature under fully-reversed, biaxial, stress or strain controlled, conditions. This assemblage of some 260 data points covers the fatigue life range from 10 to 10^7 cycles. Biaxial stress ratios, from equibiaxial (+1) to torsional (-1) are represented. By combining data a broad view of the effect of biaxiality on fatigue is obtained. Areas where data are scant or show inconsistencies become apparent and conclusions drawn have more general applicability than those based on a single investigation.

39866 Numerical plasticity and creep analysis based on the fraction model and experimental verification for AISI 304. Meijers, P.; Janssen, G.T.M. (Nijverheidsorganisatie TNO, Delft (Netherlands). Instituut TNO voor Werktuigkundige Constructies); Booij, J. (Technische Hogeschool Delft (Netherlands)). pp L3/9 1-14 of In Structural mechanics in reactor technology. Vol. 5. Jaeger, T.A. (comp.) (Bundesanstalt fuer Materialpruefung, Berlin (Germany, F.R.)). Amsterdam, The Netherlands; North-Holland (1975).

From 3. international conference on structural mechanics in reactor technology; London, UK (1 Sep 1975).

The main problem related to plasticity analysis with strainhardening and to a still greater extent to creep analysis is the fact that there is no phenomenological description available that has been sufficiently verified by experiments. A finite element description of creep and plastic deformations based on the fraction model of Besseling has been developed and applied to components of nuclear

reactors. This model was chosen because it was expected to give the best results. In this description for time-independent plastic deformations a volume element is thought to be subdivided into a set of parallel fractions of elastic-ideally plastic material with different yield limits. When necessary a small amount of isotropic hardening for each fraction may be included. The required material parameters are obtained from a uni-axial tension or a torsion test. In case of creep the parallel volume fractions show only secondary creep but with different creep rates. Due to the interaction of the fractions primary creep and recovery may be explained qualitatively. To determine the accuracy of the phenomenological description for plastic deformations in components of AISI 304, a set of bi-axial experiments on thin-walled tubes has been carried out at room temperature, with loading programmes that are a combination of tension, torsion and internal pressure. They cover the whole range of bi-axial states of stress.

39867 Failure criteria of part-through cracks in thin walls for elasto-plastic materials sensitive to strain hardening. Dufresne, J. (CCR, Joint Research Center, Ispra, Italy). *Int. J. Fract.;* **12**: No. 2, 201-215(1976).

This study is concerned with the determination of the rupture conditions of a part-through crack in a relatively thin plate or tube. Zones at the bottom of the crack and at the crack-tip which have become plastically deformed are replaced by equivalent constraining efforts exerted on the rest of the structure that is assumed to deform elastically. A subsequent elastic analysis, utilizing conformal mapping in which the appropriate boundary conditions are introduced, allows one to determine the aperture at the center of the crack. Two rupture criteria are considered. First, the stress in the connecting ligament at the center of the crack is equal to the rupture stress of the material. Second, the opening at the center of the crack is a critical material characteristic. Experimental verifications were conducted on A106B steel and on AISI 304 steel at 540°C which predicted the point of bursting of tubes within 15 percent and 10 percent respectively in 90 percent of the cases. 11 figures, 2 tables.

39868 Ni alloys for PWR exchanger tubes. Berge, P.; Donati, J.R. (Electricite de France, 77 - Ecuelles). pp 425-456 of In 18. Colloque de metallurgie. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1976). (In French)

From 18. Colloquium on metallurgy. Ni and its specific properties in certain types of alloys; Saclay, France (23 Jun 1975).

The tubes which form the steam generators of a PWR station must possess a set of mechanical and thermal characteristics and a corrosion resistance such that only austenitic stainless steels and alloys are used. 18-10 type stainless steels have been abandoned by western power station builders since 1967 in favor of Inconel 600 type high-nickel alloys, or Incoloy 800 type alloys adopted in Germany. Other alloys such as Inconel 690 are being studied with a view to improving the corrosion resistance. The choice of material for these tubes, especially between Inconel 600 and Incoloy 800, must take into account the following criteria: mechanical properties (yield strength of Incoloy 800 is lower and must be raised by cold-hardening the tubes); thermal conductivity (also to the disadvantage of Incoloy 800); thermal expansion (Incoloy 800, which has an expansion coefficient quite different from that of the steel used for the sleeves and plates, cannot be used for steam generators once through); susceptibility of the metal to contamination during manufacture, especially by sulfur products to which high-nickel alloys are very sensitive; corrosion resistance; price. These different points are discussed. The structures of these materials are compared for various compositions and heat treatments.

39869 Ferritic steel strength for nuclear application. Huet, J.J.; de Wilde, L. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)); Leroy, V. (Centre de Recherches Metallurgiques, Liege (Belgium)). pp 870-874 of In International conference on the strength of metals and alloys. Vol. 2. Nancy, France; Ecole Nationale Superieure de la Metallurgie et de l'Industrie des Mines. Laboratoire de Physique du Solide (1976).

From 4. International conference on the strength of metals and alloys; Nancy, France (30 Aug 1976).

Ferritic alloys were studied in view of their application as canning materials for fast reactor fuel. Their creep strength has to be equal to or better than that of AISI 316 at 700 deg C. A Fe-Cr base alloy with addition of Mo and Ti was chosen. The requested properties have been obtained on hot worked alloys, the structure of which can be described as a bamboo structure. Cold working destroys the structure and the mechanical properties are lost. It is, however, not the case when the alloy is made by powder metallurgy methods with addition of a ceramic oxide. In this case only, heat treatments can rebuild the bamboo structure and the alloy recovers the good mechanical properties.

39870 Surface film softening in iron single crystals. Kojima, K.; Kobayashi, S.; Meshii, M. (Northwestern Univ., Evanston, IL). *Scr. Metall.;* **10**: 347-352(1976).

The plastic deformation behavior of crystals can be markedly affected by surface films. This paper investigates the effects of Ni films on the low-temperature (77°K) deformation of iron single crystals in order to characterize the surface film softening phenomenon in iron. Stress—strain curves are shown. 8 figures. (RWR)

39871 Study of plane stress fracture in the large-scale plastic yielding regime. Tardiff, G.E. Jr. (Univ. of California, Livermore); Kuhn, B.A.; Heldt, L.A. *Am. Soc. Test. Mater., Spec. Tech. Publ.;* 115-127(1976).

Three independent methods for measuring plane stress fracture resistance in the large-scale plastic yielding regime were tested and were found to give equivalent results. The three methods were the J-integral technique, a method based on the increase in compliance that accompanies the development of a plastic zone, and a method based on the direct measurement of the plastic work that must be done to cause fracture.

39872 Allowable stresses of type 321 stainless steel for FBR. Sunamoto, D.; Sakon, T. (Mitsubishi Heavy Industries, Ltd., Takasago, Hyogo (Japan). Takasago Works); Wada, H.; Yukutoshi, T.; Yoshikawa, K. *Karyoku Genshiryoku Hatsuden;* **27**: No. 4, 361-370(Apr 1976). (In Japanese).

In fast breeder reactors, the high temperature portion reaches about 550°C, and austenitic stainless steel is expected to be used as the structural material. Generally around 500°C, the design taking creep in consideration is required even in case of stainless steel. In ASME Code Case 1592, 5 values of allowable stress and 3 design diagrams are given regarding several kinds of materials, but the typical stainless steel Type 321 is not included. Therefore, tensile, creep and fatigue tests were carried out on Type 321 steel, and the allowable stress at high temperature and the design diagram were determined. As to the results, the fatigue strength of Type 321 steel was same as that of the other stainless steels, but generally the strength of Type 321 steel exceeded that of Type 304 steel, accordingly at least, it is not necessary to use the allowable stress lower than that of Type 304 steel. According to the results of the present investigation, there are many uncertain points. Therefore, it is necessary to clarify the concept on the method of determining allowable stress and to codify it. Also the methods of making design diagrams and the data for stress and strain analysis and using them for design must be established so as to correspond to the actual situation.

39873 Computation of constant-load creep curves. Clay, B.D.; Evans, H.E. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). *Nucl. Eng. Des.;* **39**: No. 2-3, 289-292(Nov 1976).

A numerical integration is used to compute the form of the strain-time relation under uniaxial constant-load conditions using data obtained from an equivalent constant-stress test. The method is applied to creep experiments on two types of stainless steel, intended for fuel cladding in the advanced gas-cooled reactors, where significant differences are observed in both the creep strength and stress dependence of secondary creep rates. The computed constant-load curves are in close agreement with the experimental data and show that the characteristic features of enhanced secondary creep rates, and reduced times to secondary creep and failure, may be accounted for satisfactorily. The results also emphasize the importance of using constant-stress creep equations as a basis for predicting cladding endurance. Since the primary and secondary creep stages observed in constant-load tests are largely artifacts, the associated values of stress exponent and activation energy need have no physical significance.

39874 Piezoresistive effects in ytterbium stress transducers. Grady, D.E.; Ginsberg, M.J. (Sandia Laboratories, Albuquerque, New Mexico 87115). *J. Appl. Phys.;* **48**: No. 6, 2179-2181(Jun 1977).

Ytterbium has been successfully used as the piezoresistive element in stress transducers for in situ measurements of stress amplitudes associated with wave propagation in rocks and soils and for laboratory studies of high-rate loading effects in solids and liquids. Ytterbium has been calibrated over its useful range and it can be seen that consideration of the tensor aspects of the piezoresistance become important below 10 kbar. We have used static tensile and hydrostatic data to determine the piezoresistivity tensor coefficients and estimate the shock-wave piezoresistance coefficient, which compares well with experiment. In addition, we offer an explanation of the difference observed between hydrostatic and shock-wave data in the region where plastic deformation becomes important during dynamic compression.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 39846, 39846

39875 Comments on RESE in cylinders. Baer, D.R. (Cornell Univ., Ithaca, NY). *J. Phys., F (London);* **6**: No. 1, L17-L20(1976).

Field and angle derivatives of the surface impedance were measured for tungsten and potassium cylinders. Several observations are presented. 3 figures.

39876 Theoretical and experimental investigation of the magnetic characteristics of terbium and dysprosium in strong magnetic fields. Druzhinin, V.V.; Ponomarev, B.K.; Zapasskii, S.P. (Engineering-Physics Institute, Moscow). *Sov. Phys. - Solid State (Engl. Transl.);* **19**: No. 1, 25-28(Jan 1977).

Magnetization measurements were made and used to calculate by thermodynamic methods the entropy and the magnetocaloric effect (MCE) in Tb and Dy in fields reaching 350 kOe. The quantities indicated were calculated in the anisotropic-molecular-field model and the results agree well with experiment.

39877 An Auger electron spectroscopic study of the diffusion of sulfur and carbon in α-iron. Swartz, W.E. Jr.; Holloway, D.M. (Department of Chemistry, University of South Florida, Tampa, Florida 33620). *Appl. Spectrosc.;* **31**: No. 3, 210-212(May 1977).

Auger electron spectroscopy has been employed to study the diffusion of sulfur and carbon in α-iron. In the temperature range 25 to 500degreeC carbon preferentially segregates to the surface. From 400 to 700degreeC sulfur segregates to the surface while carbon is thermally desorbed. An Arrehenius analysis of the sulfur diffusion data yields an activation energy of 14.5 kcal/mol, which is consistent with a grain boundary diffusion process. The kinetics of carbon migration is complicated by the thermal desorption which makes Arrehenius analysis impossible.

39878 Far-infrared absorption in ultrafine Al particles. Simanek, E. (Department of Physics, University of California, Riverside, California 92502). *Phys. Rev. Lett.;* **38**: No. 20, 1161-1163(16 May 1977).

It is shown that the strong far-infrared absorption in small Al particles, recently observed by Granqvist et al., may be explained as arising from the dielectric losses in the amorphous oxide layers covering the particles. Aggregation of particles into clusters is found essential in order to produce the observed dependence of absorptivity on particle size. The proposed mechanism provides a simple understanding of the absence of any superconducting ordering effects in the absorption.

39879 X-ray photoemission studies of tellurium and some of its compounds. Bahl, M.K.; Watson, R.L.; Irgolic, K.J. (Cyclotron Institute and Department of Chemistry, Texas AandM University, College Station, Texas 77843). *J. Chem. Phys.;* **66**: No. 12, 5526-5535(15 Jun 1977).

The energies of the $3p_{1/2}$/sub ,/$_{3/2}$, $3d_{3/2}$/sub ,/$_{5/2}$, 4s, and $4d_{3/2}$/sub ,/$_{5/2}$ photopeaks have been measured for tellurium metal and 23 of its compounds. An attempt is made to interpret chemical bonding in some of the tellurium compounds by comparing core level binding energy shifts with isomer shifts observed through Mossbauer spectroscopy. The widths of the $3p_{3/2}$ photopeaks measured relative to the $3p_{1/2}$ photopeaks are examined for broadening by electric field gradients and Coster—Kronig transitions. Variations in the spin—orbit splitting of the tellurium 4d level in its various compounds do not seem to be dependent on crystal field interactions.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 39070, 39077, 39374, 39443, 39445, 39848, 39868

39880 (BNL-NUREG—50596) **Intergranular stress corrosion cracking of sensitized stainless steels. Final report.** Vyas, B.; Isaacs, H.S.; Weeks, J.R. (Brookhaven National Lab., Upton, N.Y. (USA)). Dec 1976. Contract EY-76-C-01-0016. 51p. Dep. NTIS $4.50.

A study was conducted of the intergranular stress corrosion cracking of materials used in Boiling Water Reactors (BWR) aimed at developing an understanding of the mechanism(s) of this mode of failure and at developing tests to determine the susceptibility of a given material to this form of attack.

39881 (CONF-761057—4) **Role of stress effects in the oxidation behavior of high temperature alloys.** Cathcart, J.V. (Oak Ridge National Lab., Tenn. (USA)). 1976. Contract W-7405-ENG-26. 25p. Dep. NTIS $3.50.

From Electrochemical Society meeting; Las Vegas, Nevada, United States of America (USA) (17 Oct 1976).

The kinetics of oxidation of many metals and alloys is influenced by oxide growth stresses generated by the oxidation process itself. In this paper factors important in stress generation are considered, and several stress relaxation mechanisms are discussed. The importance of the interaction between stress generation and relaxation mechanisms is emphasized.

39882 (CONF-7609100—1) **Effect of sodium environment on the creep-rupture behavior of austenitic stainless steel.** Natesan, K.; Chopra, O.K.; Kassner, T.F. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-ENG-38. 11p. Dep. NTIS $3.50.

From 5. international symposium on heat-resistant metal materials; Vsetin, Czechoslovakia (13 Sep 1976).

Uniaxial creep-rupture data were obtained for Type 304 stainless steel in the solution-annealed condition and after exposure to a flowing sodium environment at temperatures of 700, 650, and 600°C. The specimens were exposed to sodium for time periods between 120 and 5012 h to produce carbon penetration depths of approximately 0.010, 0.020, and 0.038 cm in the steel. The results showed that, as the depth of carbon penetration and the average carbon concentration in the steel increase, the rupture life increases and the minimum creep rate decreases. Creep correlations that relate rupture life, minimum creep rate, and time-to-tertiary creep have been developed for the steel in both the solution-annealed and sodium-exposed conditions.

39883 (Y/DA—7055) **Corrosion behavior of aluminum in water.** Schmitt, C.R.; Schreyer, J.M.; Googin, J.M. (Oak Ridge Y-12 Plant, Tenn. (USA)). 8 Feb 1977. Contract W-7405-ENG-26. 13p. Dep. NTIS $3.50.

A condensed and paraphrased summary of pertinent literature regarding the corrosion of aluminum in water is presented. Corrosion resistance and pitting are considered primarily. Also the effects of deposits and the various corrosive substances including the effects from living organisms are discussed. 9 references. (JFP)

39884 Influence of environment upon crack propagation resistance. Lloyd, G.J. (UKAEA Reactor Group, Risley). pp 1303-1308 of In International conference on the strength of metals and alloys. Vol. 3. Nancy, France; Ecole Nationale Superieure de la Metallurgie et de l'Industrie des Mines. Laboratoire de Physique du Solide (1976).

From 4. International conference on the strength of metals and alloys; Nancy, France (30 Aug 1976).

Calculations have been made of the likelihood of a continuing carburization reaction occurring at the tip of a fatigue crack propagating in sodium containing carbon. Under the assumptions made it is shown that, for a thumb-nail crack, certain regimes of interaction are definable. The case of cracks propagating under creep conditions in sodium is also discussed with reference to available results.

39885 Stress corrosion cracking of stainless steels and nickel alloys in water-cooled reactors. Ishihara, T.; Matsushima, S. (National Research Inst. for Metals, Tokyo (Japan)). *Nippon Genshiryoku Gakkaishi;* **18**: No. 3, 137-144(Mar 1976). (In Japanese).

164 nuclear reactors for power generation were in operation in the world and 12 were in operation in Japan in June, 1975. In 1974, stress corrosion cracking occurred successively in cooling pipes of light water reactors in U.S.A. and Japan, and total inspection, repair, and the reconfirmation of safety have been carried out. The stress corrosion cracking is not likely to result directly in the break-down of reactors in view of leak detection techniques at present, but the economic loss due to suspension of operation is enormous. In light water reactors, water quality control limiting the impurity content as low as possible is carried out. The examples of the stress corrosion cracking in stainless steel and nickel alloy structures are classified according to the water quality. In the study on the stress corrosion cracking of austenitic stainless steel, the effects of alloy composition, working and heat treatment, dissolved oxygen and chlorine ions, temperature and pH were investigated. In the study on that of nickel alloys, the effects of dissolved oxygen, caustic alkali, and other factors were investigated. Concerning the mechanism of stress corrosion cracking in high temperature, high pressure water, a few proposals have been made. It is desirable to establish the standard testing method for this problem, which can simulate actual environment.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 39852, 40695, 40696, 40697

39886 (HEDL-TME—76-70) **Displacement cross sections and PKA spectra: tables and applications.** Doran, D.G.; Graves, N.J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1976. Contract EY-76-C-14-2170. 127p. Dep. NTIS $6.00.

Damage energy cross sections to 20 MeV are given for aluminum, vanadium, chromium, iron, nickel, copper, zirconium, niobium, molybdenum, tantalum, tungsten, lead, and 18Cr10Ni stainless steel. They are based on ENDF/B-IV nuclear data and the Lindhard energy partition model. Primary knockon atom (PKA) spectra are given for aluminum, iron, niobium, tantalum, and lead for neutron energies up to 15 MeV at approximately one-quarter lethargy intervals. The contributions of various reactions to both the displacement cross sections (taken to be proportional to the damage energy cross sections) and the PKA spectra are presented graphically. Spectral-averaged values of the displacement cross sections are given for several spectra, including approximate maps for the Experimental Breeder Reactor-II (EBR-II) and several positions in the Fast Test Reactor (FTR). Flux values are included to permit estimation of displacement rates. Graphs show integral PKA spectra for the five metals listed above for neutron spectra corresponding to

locations in the EBR-II, the High Flux Isotope Reactor (HFIR), and a conceptual fusion reactor (UWMAK-I). Detailed calculations are given only for cases not previously documented. Uncertainty estimates are included.

39887 Characterization of reordered (001) Au surfaces by the combined techniques of positive ion channeling spectroscopy (PICS), LEED—AES, and computer simulation. Appleton, B.R.; Zehner, D.M.; Noggle, T.S.; Miller, J.W.; Schow, O.E. III; Jenkins, L.H.; Barrett, J.H. (Oak Ridge National Lab., TN). pp 607-625 of In Ion beam surface layer analysis. Vol. 2. Meyer, O.; Linker, G.; Kaeppeler, F. (eds.). New York; Plenum Publishing Corp. (1976).

The applicability of positive-ion channeling techniques for studying the structure of single-crystal surfaces was investigated. Characterization of the (001) surface of epitaxially grown Au single crystals by LEED and AES showed that, when the (001) surface was sputter-cleaned and annealed in ultrahigh vacuum, the normal (1 x 1) symmetry of the (001) surface reordered into a structure which gave a complex (5 x 20) LEED pattern as previously reported. The yield and energy distributions of 1-MeV He ions scattered from the Au surfaces were used to determine the effective number of monolayers contributing to the normal and reordered surfaces. Computer simulation calculations were used to correlate the ion scattering results with model constructions for the normal and reordered surfaces. The combined techniques of PICS, LEED-AES, and computer simulation enabled the nature of the restructured surface to be characterized as one monolayer of hexagonal symmetry superimposed on the (001) substrate. 7 figures, 1 table.

39888 Comparison of the embrittling effects of H_2O bubbles in Ag with those of He bubbles in Ni—6% W. Goods, S.H.; Nix, W.D. (Stanford Univ., CA). *Acta Metall.;* **24**: No. 11, 1041-1046(Nov 1976).

It is shown that water vapor bubbles can be introduced into polycrystalline silver via simple annealing procedures. These bubble microstructures are in certain respects very similar to those commonly found in irradiated metals. A comparison is made of the structure and embrittling effects of H_2O bubbles in Ag with those of He bubbles in Ni—6 percent W. It is shown that H_2O bubbles in Ag promote intergranular fracture, as do He bubbles in Ni—6 percent W. It is concluded that certain aspects of helium embrittlement induced by irradiation can be simulated by the Ag—H_2O system. 7 figures.

CERAMICS, CERMETS, AND REFRACTORIES

39889 System employing laser heating for the measurement of high-temperature properties of materials over a wide pressure range. Whittaker, A.G.; Kintner, P.L.; Nelson, L.S.; Richardson, N. (The Aerospace Corporation, El Segundo, California 90245). *Rev. Sci. Instrum.;* **48**: No. 6, 632-639(Jun 1977).

An equipment system is described that can be used to obtain high-temperature physical property data on refractory materials by means of laser heating. Properties that can be measured are the vapor pressure of solid and liquid phases, the relative rate of vaporization, and emission spectra from solid and vapor phases. Solid phases can be studied by splat-cooling of the liquid and quench-cooling of the solid and vapor. Temperature can be measured both pyrometrically and spectroscopically. In addition, the effects produced by heating a material in an atmosphere of controlled composition and pressure can be studied.

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 39296, 39302, 39303, 39304, 39365

39890 (LBL—5763) Sintering of Al_2O_3 powder compact by hot stage scanning electron microscopy. Wang, D.N.K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1976. Contract W-7405-ENG-48. 144p. Dep. NTIS $6.00.

Thesis.

Previous sintering studies on Al_2O_3 powder compacts have concentrated on the use of isothermal techniques. A complete analysis of sintering kinetics is unattainable due to uncertainties involved in the initial heating period. This work has used a constant heating rate technique to study MgO-doped and undoped Al_2O_3 powder compacts with variations in green density. Hot stage scanning electron microscopy was used to monitor continuously the linear dimensional change of a powder compact throughout the densification process at various constant heating rates. Extensive studies on the microstructural evolution were made and correlated with the densification and grain growth kinetics. The maximum densification rate was found to occur at a critical density which was independent of the heating rate as long as the green density remained constant. Microstructural evolution has been correlated with the densification rate to explain the occurrence of the maximum rate of densification. The effect of MgO dopant on the densification and grain growth of Al_2O_3 compacts was also studied. It was found that there is no effect of MgO dopant on either process until the critical density is reached. Before the attainment of the critical density, the grain growth kinetics is characterized by grain boundary self-diffusion. After the critical density, the densification kinetics and grain growth kinetics are inter-dependent and characterized by the same activation energy. The grain growth rate is limited by the pore phase and obeys Zener's criterion. In accordance with the porosity changes, the sintering process can be divided into four stages.

39891 Method for preparing single crystal LaB_6 cathodes. Gibson, E.D.; Verhoeven, J.D. (to Energy Research and Development Administration). US Patent Application 652,695. 27 Jan 1976. 10p.

A method for preparing single crystals of lanthanum hexaboride (LaB_6) by arc melting a rod of compacted LaB_6 powder is described. The method is especially suitable for preparing single-crystal LaB_6 cathodes for use in scanning electron microscopes (SEM) and scanning transmission electron microscopes. (STEM). 1 figure, 1 table.

39892 Dense sintered boron carbide containing beryllium carbide. Prochazka, S. (to General Electric Co.). US Patent 4,005,235. 25 Jan 1977. Filed date 17 Nov 1975. 6p.

A polycrystalline boron carbide sintered body containing beryllium carbide with a density ranging from 85 percent to 96 percent of the theoretical density of boron carbide and having a uniform microstructure of equiaxed grains is discussed. 2 figures, 1 table.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 39890

39893 (LBL—5706) Mullite phase equilibria in the system: $CaO—Al_2O_3—SiO_2$. Draper, V.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1976. Contract W-7405-ENG-48. 80p. Dep. NTIS $5.00.

Thesis.

Sapphire-liquid diffusion couples annealed in sealed molybdenum crucibles in the temperature range of 1602°C to 1787°C were analyzed by electron beam microprobe. Interfacial compositions across the phase boundaries were used to determine the stable composition range of the mullite phase field and the location of the mullite-corundum boundary. Experiments utilizing quenching methods were also conducted to establish the extent that the metastable nature of the Al_2O_3-SiO_2 system extended into the ternary CaO-Al_2O_3-SiO_2 system and to determine any solid solubility of CaO in mullite. Further evidence was obtained to confirm the recognized value of approximately 82.5 wt percent Al_2O_3 as the upper solubility limit for metastable disordered mullite in the binary Al_2O_3-SiO_2 system.

39894 (N—76-27362) Phase diagram of the system Al_2O_3—La_2O_3 at elevated temperature. Mizuno, M.; Berjoan, R.; Coutures, J.P.; Foex, M. Translated from *Yogyo Kyokai Shi;* **82**: No. 12, 631-636(1974). 16p. (NASA-TT-F—17070). NTIS $3.50.

The solidification points of the Al_2O_3—La_2O_3 system were obtained from cooling curves, by using a solar furnace. Results different from those reported previously were obtained with the composition of 99.0—60.0 mol% La_2O_3. By microscopic high-temperature x-ray diffractometry and cooling curve observations, the presence of a new compound R phase was confirmed at the composition 80.0 mol% La_2O_3. From these results, a high-temperature equilibrium phase diagram for the Al_2O_3—La_2O_3 system was inferred. (auth)

39895 (N—76-27363) Phase diagram of the system Al_2O_3—CeO_2 at liquidus temperature. Mizuno, M.; Berjoan, R.; Coutures, J.P.; Foex, M. Translated from *Yogyo Kyokai Shi;* **83**: No. 2, 90-96(1975). 20p. (NASA-TT-F—17071). NTIS $3.50.

The liquidus curve in the system Al_2O_3—CeO_2 was determined by using a heliostat-type solar furnace. The cooling curves of melted specimens were obtained in the black body centrifugal cavity with an optical pyrometer. The quenched specimens were examined by powder x-ray techniques and petrographic microscopy. Anomalies in the liquidus curve of the system were found in the regions between 70.0 and 95.0 mol% CeO_2. A composition of 90.0 mol% CeO_2 was further examined by the high-temperature powder x-ray diffractometry, and the presence of a new orthorhombic phase was established. A tentative phase diagram for the Al_2O_3—CeO_2 system at high temperatures is presented. (auth)

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 39305, 39846

39896 Thermal diffusivity of nonstoichiometric titanium dioxide. Siebeneck, H.J. (Lehigh Univ., Bethlehem, PA); Minnear, W.P.;

Bradt, R.C.; Hasselman, D.P.H. *J. Am. Ceram. Soc.;* **59**: No. 1-2, 84(1975).

Thermal diffusivities of small polycrystalline TiO_2 disks were measured by the laser-flash technique. Measurements were made between 200 and 800°C. Lattice defects were found to affect the rate of heat transfer via phonon processes significantly. The relative effect of the presence of the defects on the conductivity decreases with increasing temperature. 1 figure. (RWR)

39897 Spectrum of Raman scattering of light and phase transition in VO_2. Aronov, A.G.; Mirlin, D.N.; Reshina, I.I.; Chudnovskii, F.A. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. Phys. - Solid State (Engl. Transl.);* **19**: No. 1, 110-114(Jan 1977).

The spectrum of Raman scattering (RS) of light was investigated in the crystals VO_2 and V$_1$/sub -/Nb/sub x/O_2 and in polycrystalline VO_2 films in the semiconductor phase. Polarization measurements were used to determine the symmetry types for the vibrations corresponding to the observed bands. The temperature dependences of the frequencies, of the line widths, and of the intensities were investigated as the temperature approached the temperature of the insulator—metal phase transition. Anomalous broadening of the lines was observed as TyieldsT/sub c/. While this effect does not admit of an unambiguous interpretation, it is more likely to be connected with the anharmonic broadening with participation of a phonon of the soft mode that changes the symmetry of the lattice and causes the phase transition. In the metallic phase, the phonon structure vanishes completely from the RS, a fact that apparently cannot be attributed to electron—phonon interaction.

39898 Spectrum of Raman scattering of light in the metallic and semiconducting phases of V_2O_3. Mirlin, D.N.; Reshina, I.I. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. Phys. - Solid State (Engl. Transl.);* **19**: No. 1, 115-117(Jan 1977).

We measured the spectra of Raman scattering of light in V_2O_3 spectra in a temperature range that included the semiconductor—metal phase transition. The symmetry types for the vibrations corresponding to the observed bands were determined on the basis of polarization measurements. In contrast to the previously observed phase transition in VO_2, the intensities band widths in the Raman-scattering spectrum of V_2O_3 do not undergo abrupt changes on going over into the metallic phase. The additional contribution to the phonon width on going into the metallic phase amounts to 4—6 cm^{-1}.

39899 The properties of layers of the rare-earth element oxides, obtained by electron-beam evaporation in vacuum. Dement'ev, A.V.; Pridatko, G.D.; Kryzhanovskii, B.P. *Sov. J. Opt. Technol. (Engl. Transl.);* **44**: No. 1, 35-37(Jan 1977).

Layers of rare-earth element oxides have been prepared by electron-beam evaporation in vacuum, and their optical and operational characteristics have been investigated. The use of these oxides in multilayer interference systems is recommended.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 39091

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 39515

COMPOSITE MATERIALS

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 39900

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 39306

39900 (CONF-760829—53) **Critical current changes and fatique damage.** Fisher, E.S.; Kim, S.H. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-ENG-38. 5p. Dep. NTIS $3.50.

From Applied superconductivity conference; Stanford, California, United States of America (USA) (17 Aug 1976).

A facility for investigating the effects of cyclic strains on the current-voltage relation (I-V plots) in a superconducting composite has been constructed as part of the conductor test program directed by Oak Ridge National Laboratory for the Tokamak Experimental Power Reactor. The initial results for a ribbon composite containing 18 Nb—Ti twisted filaments in copper showed three effects: (1) a 3 percent decrease in I/sub c/ at 40 kOe during the initial 200 cycles at 0.35 percent maximum strain amplitude, (2) current sharing between filaments and copper at I less than I/sub c/ after cycling with maximum strain increased to 0.57 percent and (3) voltage steps at I greater than I/sub c/ after 400 cycles with 0.57 percent strain amplitude. The first effect is consistent with I/sub c/ measurements in unidirectional testing and appears to be associated with elastic strain fields. The third effect, the voltage steps at I greater than I/sub c/ introduced by the higher strain amplitudes, decreased very significantly with increasing magnetic field and disappeared at H greater than 40 kOe. A Nb_3Sn composite fractured during tension-compression cycling, but no damage occurred in 3800 load-unload cycles at strains up to 0.2 percent.

POLYMERS AND PLASTICS

STRUCTURE AND PHASE STUDIES

39901 Polymeric equations of state. Curro, J.G. (Sandia Labs., Albuquerque, NM). pp 321-366 of In Review in macromolecular chemistry. Vol. 12. New York; Marcel Dekker, Inc. (1975).

This paper reviews literature data related to the experimental determination and theoretical considerations of equations of states for crystalline polymers, polymer liquids and polymer glasses. The regularity of crystalline polymers permits detailed equation of state calculations, provided the crystal structure is known. Pastine performed such calculations on crystalline polyethylene; this method is in principle applicable to other crystalline polymers as well. Amorphous polymers present a more formidable theoretical problem. Prigogine and co-workers used a modification of the Lennard-Jones and Devonshire cell model to derive an equation of state for chain molecule liquids. Flory's partition function and Simha's hole theory for polymer liquids are followed by a low-temperature equation of state for polymer glasses which can be achieved with a cell model and harmonic oscillator approximation to the cell potential. 113 refs.

39902 Utility of multiple-pulse NMR to determine the amorphous fraction of polyethylene. Pembleton, R.G.; Wilson, R.C.; Gerstein, B.C. (Ames Laboratory—ERDA and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *J. Chem. Phys.;* **66**: No. 11, 5133-5136(1 Jun 1977).

Multiple pulse NMR techniques are utilized to determine the amorphous fraction of polyethylene. The averaging condition of the multiple pulse experiment, t/sub c/parallelH/sub int/parallelvery-much-less-than1, where t/sub c/ is the cycle time and parallelH/sub int/parallel the magnitude of the internal interaction averaged by the multiple pulse sequence in question, allows for unique separation of the response of the protons in the amorphous phase from the response of the total system by means of appropriate adjustment of t/sub c/.

OTHER MATERIALS

PREPARATION AND MANUFACTURE

39903 (ORNL-tr—4273) **Deposition of pyrolytic carbon from C_2H_2—C_3H_6—Ar gas mixtures: coating under adiabatic conditions.** Gyarmati, E.; Gupta, A.K.; Puetter, B. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Jul 1976. Translation by R.G. Mansfield of JUL—1317. 39p. P 03/MF A01.

In this report a method is described by which pyrolytic carbon can be deposited from ethylene-propylene-argon gas mixtures at temperatures between 1230 and 1330°C in 55-mm fluidized bed apparatus without heat exchange with the apparatus.

STRUCTURE AND PHASE STUDIES

39904 Pyridinium tetrabromoantimonate(III) C_5H_5NH Sb(III)Br_4. DeHaven, P.W.; Jacobson, R.A. (Ames Lab., Iowa). Contract W-7405-eng-82. *Cryst. Struct. Commun.;* **5**: 31-34(1976).

Data were collected at room temperature by use of an automated four-circle diffractometer. 1376 reflections were measured. Analysis of the three-dimensional Patterson function showed the Sb to lie on a twofold rotation axis at (0, y, 1/4). Positions of all remaining atoms (except H) were found by successive structure factor and electron density map calculations. Bond angles and lengths, atomic coordinates, and other data are tabulated. The structure of $(C_5H_5NH)SbBr_4$ is very similar to that of the corresponding chloride. Each Sb atom has a distorted octahedral environment, with all Br—Sb—Br angles close to 90°. 1 figure, 2 tables. (RWR)

39905 Tris(nitrato)tetraaquopraseodymium(III) dihydrate, $Pr(NO_3)_3(H_2O)_4.2H_2O$. Fuller, C.C.; Jacobson, R.A. (Ames Lab., Iowa). Contract W-7405-eng-82. *Cryst. Struct. Commun.;* **5**: 349-352(1976).

The crystal and molecular structure was measured with a four-circle automated diffractometer. 1858 intensities were measured. The heavy atom was located by analyzing a three-dimensional Patterson function, and remaining atoms were found by structure

factor and electron density map calculations. Some interatomic distances and angles are tabulated. The results generally agree with earlier work. This compound was found to be virtually isostructural with the decacoordinate compound tris(bicarbonato)tetraaquoholmium (III) dihydrate. 1 figure, 3 tables. (RWR)

39906 Nd^{3+} multiplet splittings in YAG using an effective ligand point-charge model. Mroczkowski, J.A.; Randic, M. (Departments of Physics and Chemistry, Tufts University, Medford, Massachusetts 02155). *J. Chem. Phys.;* **66**: No. 11, 5046-5053(1 Jun 1977).

An investigation of the $4f^3$ $^4I_{9/2}$, $^4I_{15/2}$, $^4F_{3/2}$, and $^4F_{9/2}$ multiplet splittings of Nd^{3+} in YAG was undertaken on the basis of an explicit point-charge model. A fit between optical data and the 20 calculated energy levels was made within a 22.7 cm^{-1} standard deviation using only three adjustable parameters. A physical representation of the crystal field at Nd^{3+} sites could not be achieved solely on the basis of a model of surrounding ion point charges located at the ion sites. However, when the effects of a strong covalency contribution to the crystal field were simulated by a model of effective ligand point charges, a satisfactory representation of the YAG crystal field was obtained.

PROPERTIES

REFER ALSO TO CITATION(S) 39197, 39942, 40522

39907 Pressure and temperature dependence of the elastic moduli of a low-expansion lithium aluminum silicate glass-ceramic. Yul Kim, K. (Cornell Univ., Ithaca, NY); Ruoff, A.L. *J. Am. Ceram. Soc.;* **58**: No. 7-8, 352(1975).

The behavior of the elastic moduli at high pressures and temperatures was investigated. A quadratic expansion was made for C_{11}/sup s/, C_{44}, and B/sup s/ at 298°K. The values are felt to be valid up to at least 4 kbars. It was found that the glass-ceramic becomes softer with increasing pressure and stiffer with rising temperature. The data suggest a macroscopic elastic instability of B when the pressure exceeds 16.3 kbars. 1 table. (RWR)

39908 Constitutive equations and punch-indentation of concrete. Chen, A.C.T. (Gilbert Associates, Inc., Reading, PA); Asce, A.M.; Chen, W.F.; Asce, M. *J. Eng. Mech. Div., Am. Soc. Civ. Eng.;* **101**: No. EM6, 889-906(Dec 1975).

The analysis of plane and axisymmetric problems with concrete-like material behavior is discussed; the weak tensile strength and crushing and cracking behavior are considered. The concrete is treated as a linear elastic, plastic, strain-hardening, and fracture material. The stress—strain relations are first stated in matrix form for the general case of three-dimensional stress states and then reduced to the special cases of plane stress, plane strain, and axisymmetric stress conditions, suitable for use in finite-element analysis. The numerical analysis is obtained within the framework of the finite-element method and a step-by-step integration procedure. The method is applied to the punch-indentation problems of concrete and metal blocks under plane strain conditions. Comparisons between analysis and experiment are made. 8 figures.

39909 Investigation of the steady creep of a spherical cavity in a half space. Anderson, C.A. (Los Alamos Scientific Lab., NM). *J. Appl. Mech.;* **98**: No. 2, 254-258(Jun 1976).

The stability of a spherical cavity in a half space of a creeping material is investigated. The finite-element method with a nearly incompressible formulation and a stable method of time stepping is used to predict the steady creep state from an initial elastic state. Applications are made to thermal creep problems involving pure halite which obeys a well-documented creep law of the Weertman form. For a spherical cavity in a half space of halite various steady motions are observed depending on the depth, the temperature field, and the internal pressurization of the cavity. 6 figures, 2 tables.

39910 Calculation and measurement of the vibrational spectrum of calcium uranyl phosphate hexahydrate. Nikanovich, M.V.; Kvorikov, A.B.; Popov, V.G.; Sevchenko, A.A.N.; Umreiko, D.S. (Applied Physics Research Institute, Lenin University of Belorussia, Minsk). *Sov. Phys. - Dokl. (Engl. Transl.);* **21**: No. 11, 653-655(Nov 1976).

By adjusting the force constants, satisfactory agreement is obtained between the calculated vibrational structure of calcium uranyl phosphate hexahydrate and that determined from measurements of the infrared and Raman spectra.(AIP)

39911 Second- and third-order piezoelectric stress constants of lithium niobate as determined by the impact-loading technique. Graham, R.A. (Sandia Laboratories, Albuquerque, New Mexico 87115). *J. Appl. Phys.;* **48**: No. 6, 2153-2163(Jun 1977).

Determination of the e_{22}, e_{33}, and e_{15} second-order piezoelectric stress constants, several third-order piezoelectric stress constants, and the c/sup D/$_{11}$ and c/sup D/$_{33}$ elastic stiffness constants are reported for lithium niobate from experiments with input strains from 7×10^{-4} to 8×10^{-3} produced by the elastic impact-loading method. Measurements of the e_{33} constant were made on a large number of samples to establish sample uniformity. The differences were found to be less than 1%. The present value of e_{33} is higher than that reported in previous work and appears to call for a revision of the accepted value along with that of the elastic constant c/sup E/$_{33}$. The third-order piezoelectric stress constants are readily detectable, but the values determined in the present investigation are limited in accuracy due to the relatively low strains which could be applied to the samples before conductivity became excessive.

39912 Infrared studies of new one-dimensional tetracyanoplatinates containing the bifluoride ion. Basile, L.J.; Ferraro, J.R.; Williams, J.M. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.;* **66**: No. 11, 4941-4942(1 Jun 1977).

New one-dimensional tetracyanoplatinate (TCP) conductors of the type $M_2[Pt(CN)_4](FHF)_0$/sub ./$_{30}$/sub en-dash/$_0$/sub ./$_{40}$ where M=Rb$^+$, Cs$^+$, and $K_2[Pt(CN)_4](FHF)_0$/sub ./$_{30}$xxH_2O, were studied by infrared techniques and the fluorine in these compounds was shown to be present as the bifluoride ion $(FHF)^-$. The asymmetric hydrogen—fluorine stretching vibration was found to be cation dependent, and occurs at higher frequency for the K$^+$ salts, as compared to the Rb$^+$ and Cs$^+$ salts. In contrast to the anion and cation-deficient one-dimensional TCP conductors, only one intense CN stretching mode at ~2150 cm^{-1} was observed. The rubidium and cesium salts are lustrous, metallic-gold in color, and appear to be optically different from the reddish-bronze prototype materials, $K_2[Pt(CN)_4]X_0$/sub ./$_3$ x3H_2O where X=Br or Cl.

39913 Pressure dependent Raman spectra of the fast ion conductors Ag_2HgI_4 and Cu_2HgI_4. Greig, D.; Shriver, D.F.; Ferraro, J.R. (Department of Chemistry and Materials Research Center, Northwestern University, Evanston, Illinois 60201). *J. Chem. Phys.;* **66**: No. 11, 5248-5250(1 Jun 1977).

The pressure dependent Raman spectra of the simple ionic conductors Ag_2HgI_4 and Cu_2HgI_4 is reported.(AIP)

CORROSION, EROSION, AND DEGRADATION

REFER ALSO TO CITATION(S) 39573

RADIATION EFFECTS

39914 Interaction of deep-level impurity atoms with radiation defects in γ-irradiated silicon. Bakhadyrkhanov, M.K.; Zainobidinov, S.; Teshabaev, A.T. (V. I. Lenin State University, Tashkent). *Sov. Phys. - Semicond. (Engl. Transl.);* **11**: No. 2, 165-167(Feb 1977).

An experimental investigation of the electrical, photoelectric, and optical properties of silicon compensated with nickel, cobalt, and manganese established that the electrical properties of these materials were not affected by ^{60}Co γ rays in a wide range of doses. Irradiation created radiation centers in a concentration of ~10^{17} cm^{-3} but only a small proportion (~5×10^{13} cm^{-3}) of them was electrically active. The observed effects were attributed to the interaction of nickel, cobalt, and manganese impurity atoms with radiation defects.

39915 Accumulation of radiation defects as a result of ion bombardment of GaP single crystals. Churin, S.A.; Frolov, I.A. *Sov. Phys. - Semicond. (Engl. Transl.);* **11**: No. 2, 241-242(Feb 1977).

Surface layers of single crystals of n-type GaP became amorphous when bombarded with Zn^+, Cd^+, S^+, Si^+, Ar^+, and N^+ ions of 50—100 keV energy. This was due to accumulation of radiation effects.

CHEMISTRY

39916 Role of angular momentum in unimolecular kinetics: Kinetic energy release in fragmentation of $C_4H_8^+$. Klots, C.E.; Mintz, D.; Baer, T. (Oak Ridge National Laboratory, Oak Ridge, Tennesse 37830). *J. Chem. Phys.;* **66**: No. 11, 5100-5104(1 Jun 1977).

The kinetic energy release distributions in the fragmentation $C_4H_8^+$ yields$C_3H_5^+ + CH_3$ at selected energies are reported and are compared with the analogous distributions from "metastable" $C_4H_8^+$ and from $C_2H_2^+ + C_2H_4$ collision complexes. The data seem to reflect the role of angular momentum in the collision experiments, as predicted by the Langevin model of the quasiequilibrium theory.

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 40237, 40238

39917 **Characterization of petroleum sulfonates.** Sandvik, E.L.; Gale, W.W.; Denekas, M.O. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—44).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

The majority of surfactant systems considered for enhanced oil recovery include petroleum sulfonates as the primary component. Previous work has shown a marked dependence of petroleum sulfonate performance upon its composition. Although numerous analyses for sulfonate surfactants are described in the published literature, care must be exercised in application of these procedures to oil recovery agents. Published procedures, in general, have been developed for sulfonates having relatively narrow equivalent weight distributions and can cause significant errors when applied to petroleum sulfonates. Included in this paper are techniques for characterization of laboratory or plant manufactured samples as well as samples produced from laboratory core or field tests. Steps described in characterization include separation and purification, gravimetric analysis, colorimetric analysis, determination of average equivalent weight and equivalent weight distribution, and estimation of relative content of mono-, di-, and poly-sulfonates. For some analyses, procedures are described to minimize errors caused by changes in composition due to preferential separation of sulfonate components in displacement tests. A procedure is described for separation of a manufactured sulfonate into equivalent weight fractions. These fractions may be recombined in different ratios to examine behavior of sulfonates having various compositions. Analysis of petroleum sulfonates made by different reaction schemes shows that sulfonate composition may be substantially influenced by choice of sulfonation conditions.

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 39289, 39924, 40496

39918 (N—76-29386) **Rapid method for the determination of mercury traces by neutron activation analysis and mercury content of biological materials of different geographic and time origins.** Rohde, H. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Radiochemie). Aug 1975. 83p. (KFK—2201). Q 05/MF A01.

A rapid method based on activation analysis was developed for the determination of mercury in biological material. The method employs the delayed gamma rays as prompt gamma rays have been shown to display insufficient sensitivity. The mercury content of 182 fish derived from the waters of the region of southwestern Germany was determined. Relatively high concentrations (1 ppM) were measured in the muscle of Rhine fish. Similar mercury contents were observed in aged biological material (bird feathers and human hair) and contemporary living organisms. (Author) (GRA)

39919 **Neutron activation analysis method for the determination of neptunium in sub-microgram quantities in process solutions.** Raghavan, R.; Ramakrishna, V.V.; Patil, S.K.; Ramaniah, M.V. (Bhabha Atomic Research Centre, Bombay (India). Radiochemistry Div.). *J. Radioanal. Chem.;* **33**: No. 1, 31-38(1976).

8 refs.; 3 tabs.

Neutron activation analysis methods, for the estimation of sub-microgram level ^{237}Np present in process solutions of a fuel reprocessing plant are described. Calibration standards were prepared using ^{237}Np solutions evaporated on Al-foils, on thin cellophane sheets, in quartz vials. The irradiated samples were counted after chemical separation (in the case of Al-foil) or counted directly (in the other cases). Synthetic samples of neptunium, along with uranium and plutonium were prepared on Al-foils. After irradiation the samples were chemically processed prior to counting. It seems possible to estimate even nanogram quantities of ^{237}Np by this technique.

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 39105, 40124, 40134, 40140, 40187

39920 (BNL—22440) **Chemical-analytical techniques for aerosols.** Tanner, R.L.; Newman, L. (Brookhaven National Lab., Upton, N.Y. (USA)). 1977. Contract EY-76-C-02-0016. 31p. P 03/MF A01.

Techniques for sampling and analysis of airborne particles for the purpose of determining the chemical composition of the sulfate therein are described. This analytical methodology was applied to speciation of airborne sulfate in several locations and sampling regimens with time resolution of 1 hr or less and with size discrimination in the suboptical particle size range. The benzaldehyde extraction technique was shown to specifically determine sulfuric acid in the presence of bisulfates and sulfates at the 10 μg sulfate level by laboratory experiments and in field studies. The sulfate mass at the semi-rural BNL sampling site is frequently dominated by sulfuric acid and/or its ammonia-neutralization products. Aerosol sulfur and sulfate levels measured by several techniques under carefully controlled conditions may vary by as little as +- 20 percent. Aerosol sulfate fractions in the fine particle range are about 90 percent and may consist of greater than 80 percent ammonium sulfate. Emissions from a fleet of catalyst-equipped vehicles at the GM Sulfate Dispersion Experiment resulted in increased sulfate burdens of 3 to 6 $\mu g/m^3$ at the immediate roadside. More acidic sulfate may be present in small particles at coastal receptor sites than at continental sites. A significant portion (ca. 50 percent) of sulfate mass exists in the particle size region below 0.3 μm.

39921 (BARC—800) **Analysis of gases in metals: the dc arc gas chromatographic technique. Part IV. Simultaneous determination of H_2, O_2, and N_2 in metals using argon as inert gas medium.** Wahi, P.K.; Biswas, S.S. (Bhabha Atomic Research Centre, Bombay (India)). 1975. 13p. U.S. Sales Only.

A method for the simultaneous determination of H_2, O_2 and N_2 in metals by the dc arc gas chromatographic technique has been developed employing a β-ray ionization detector which makes use of the indigenously available argon as a carrier gas. Detection limits for H_2, O_2 and N_2 are 2 gamma, 10 gamma, and 10 gamma respectively. With a sample volume of 3 ml, the standard curves were linear in the concentration range 0 to 25 gamma (H_2), 0 to 80 gamma (N_2) and 0 to 150 gamma (O_2). The standard deviation varies from +-12 percent near the low concentration end to +-5 percent at the higher concentration end of the linear range. Preliminary studies have shown that nickel could be used as a bath material instead of platinum for the extraction of O_2 from zirconium metal. (Atomindex citation) (GRA)

39922 **Use of graphitized carbon beads for gas liquid chromatography.** Talmi, Y.; Pollock, C.B. (to Energy Research and Development Administration). US Patent 3,988,919. 2 Nov 1976. Filed date 7 Oct 1975. 4p.

PAT-APPL-620,459.

Carbonized resin microspheroids are used as a column packing in gas-solid chromatography and as a support in gas-liquid chromatography. 5 claims, 2 figures.

39923 **Application of gas—liquid chromatography to analysis of atmosphere pollution.** Rudenko, B.A.; Smirnova, G.I. (Inst. of Organic Chemistry, Moscow). *Zh. Anal. Khim.;* **32**: No. 2, 367-382(Feb 1977). (In Russian).

The analytical applications of gas-liquid chromatography to the analysis of air pollution are discussed on the basis of an extensive bibliographic review. Techniques for carrying out the analysis are discussed with a consideration of the condensation of microimpurities in cold traps, passing air through liquid sorbents, chemical trapping of the components, and trapping by various sorbents. The determination of the atmospheric pollution by different chemical species such as inorganic gases, CO_2, methane, light hydrocarbons, automobile exhaust gases, polycyclic aromatic hydrocarbons, organic compounds containing S, and various other classes of compounds are reviewed. 323 references. (JSR)

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 39146

39924 (BNWL-SA—5287) **^{129}I analysis methodology.** Brauer, F.P.; Tenny, H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 4 Apr 1975. Contract EY-76-C-06-1830. 37p. P 03/MF A01.

Iodine-129 is present in the environment from natural man-made sources. The major man-produced sources are nuclear weapons tests and irradiated nuclear fuel reprocessing plants. Because of its long half-life (1.6×10^7 years), ^{129}I is an excellent tracer for environmental processes involving other iodine isotopes. Environmental concentrations of ^{129}I and its ratio to natural iodine (^{127}I) are being studied at several laboratories including the Pacific Northwest Laboratory (PNL). As the result of the low specific activity, the low environmental levels and the low-energy radiation of ^{129}I, analysis of ^{129}I in environmental samples generally requires separation of the iodine from the material sampled. Both field concentration and laboratory methods are used for iodine separations. Laboratory separations have been achieved with solution chemistry methods and combustion methods. Methods used to measure ^{129}I include liquid scintillation counting, low-level beta counting, gamma-ray spectrometry, x-ray spectrometry, coincidence counting, neutron activation analysis and mass spectrometric analysis. Selection of a ^{129}I analysis method is dependent on facilities, required response time, required sensitivity and whether a concentration measurement or an isotopic ratio ($^{129}I/^{127}I$) is required. This paper discusses ^{129}I analysis methodology and presents PNL's baseline data for ^{129}I environmental studies.

39925 (LA—5651-M(Suppl.)) **Fundamentals of passive nondestructive assay of fissionable material: laboratory workbook.** Reilly, T.D.; Augustson, R.H.; Parker, J.L. Walton, R.B.; Atwell, T.L.;

Umbarger, C.J.; Burns, C.E. (Los Alamos Scientific Lab., N.Mex. (USA)). Feb 1975. Contract W-7405-ENG-36. 68p. Dep. NTIS $4.50.

This workbook is a supplement to LA-5651-M, "Fundamentals of Passive Nondestructive Assay of Fissionable Material" which is the text used during the Nondestructive Assay Training Session given by Group A-1 of the Los Alamos Scientific Laboratory. It contains the writeups used during the six laboratory sessions covering basic gamma-ray principles, quantitative gamma-ray measurements, uranium enrichment measurements, equipment holdup measurements, basic neutron principles, and quantitative neutron assay.

39926 Determination of transuranics in environmental water. Golchert, N.W.; Sedlet, J. (Argonne National Lab., IL). pp 152-157 of In High-level radioactive waste management. Campbell, M.H. (ed.). Washington, DC; American Chemical Society (1976).

From 167. national meeting of the American Chemical Society; Los Angeles, California, USA (31 Mar 1974).

See CONF-740349—P3.

One of the requirements of any nuclear facility is to monitor the effluent waste water to show compliance with existing standards. This paper describes a sequential procedure for the separation of the transuranic elements from water samples up 60 l. The elements of interest are coprecipitated with calcium fluoride and then individually separated using a combination of ion exchange and solvent extraction, with a final sample preparation by electrodeposition. Alpha spectrometry of these samples allows the measurement of neptunium, plutonium, and transplutonium nuclides at sub-fCi/l. levels.

39927 Determination of U and Th concentration in biotites from the Strzegom granitoids by means of absorption of alpha-particles. Rymaszewska, M.; Zejmo, I. (Warsaw Univ. (Poland). Instytut Geofizyki). *Przegl. Geofiz.;* **21**: No. 1, 51-56(1976). (In Polish).

A new method of radiometric analysis of uranium and thorium concentration in rocks and minerals by means of absorption of alpha-particles, was elaborated. Natural α activity has been measured by means of the method of absolute measurements (using scintillation probe ZnS/Ag with amplifier adapted to work with a transistor computer) according to Evans formula. Examined biotite samples come from biotite granites from the Strzegom area. It was shown that the biotites from the granites of Kostrza type are richer in radioactive elements than the biotites found in the region of Chwalkow. This method allows for fast and exact measurements of U and Th concentration and is especially useful in serial investigations.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 39104, 39137, 39252, 39920, 39924, 39945, 39968, 39990, 39992, 40134, 40136, 40140

39928 (LA—6683-MS) **Fluorometric determination of uranium in natural waters.** Hues, A.D.; Henicksman, A.L.; Ashley, W.H.; Romero, D. (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1977. Contract W-7405-ENG-36. 15p. (GJBX—24(77)). P 02/MF A01.

Duplicate 200-μl aliquots of the water samples, as received, are transferred by means of Eppendorf pipettors onto 0.4-g pellets of 2 percent LiF-98 percent NaF flux, contained in platinum dishes. The pellets are dried under heat lamps; then fused over special propane burners. The fused pellets are transferred to a Galvanek-Morrison fluorometer, where they are excited with ultraviolet radiation and the fluorescence is measured. The uranium is calculated by comparing the measured fluorescence with that of other pellets, carried through the same procedure, which contain aliquots of standard uranium solutions. The sensitivity of the method is about 0.2 ppB of uranium, and the precision is approximately 15 relative percent in the 0.2- to 10-ppB uranium concentration range.

39929 (Y—2073) **Rapid determination of uranium in natural waters by thermal emission mass spectrometry.** Ferguson, J.R.; Caylor, J.D.; Rogers, E.R.; Cole, S.H. (Oak Ridge Y-12 Plant, Tenn. (USA)). Mar 1977. Contract W-7405-ENG-26. 13p. P 02/MF A01.

A method has been developed to rapidly analyze natural water samples for part-per-trillion (ng/l) concentrations of uranium using a custom-built thermal-emission mass spectrometer. The filtered water sample is spiked with ^{233}U as an internal standard and extracted with a 2 percent solution of TOPO (trioctylphosphine oxide) in carbon tetrachloride. An aliquot of the organic phase is evaporated and the uranium in the residue extracted with aqueous ammonium carbonate. A 5-μl aliquot is taken and dried on a flat rhenium ribbon filament and inserted into the mass spectrometer. A uranium concentration of 3 ng/l will yield a count rate greater than three times the standard deviation, plus the mean of the background, and is defined as the lowest determinable concentration. The standard deviation of the method is 3 percent at 800 ng/l, 16 percent at 8 ng/l, and 20 percent at 5 ng/l. The accuracy of the method has been evaluated by comparing the results with a fluorescence procedure. There is very good agreement for water samples with uranium concentrations from 200 to 1000 ng/l. The mass spectrometer is a 6-inch-radius, 60-degree-sector instrument equipped for ion counting and having a vacuum system allowing rapid sample changing while maintaining a high source vacuum. A multiplexer and high-voltage switch provide synchronized peak switching and scaler gating for monitoring three isotopes of uranium 238, 235, and 233. With this instrument, an analyst can achieve an analysis rate in excess of 50 samples per eight-hour shift.

39930 Exploitation of molecular motion in the analysis of complex ESR spectra by ELDOR spectroscopy. Mottley, C.; Chang, K.; Kispert, L. (Univ. of Alabama, Tuscaloosa). Contract AT(40-1)-4062. *J. Magn. Resonance;* **19**: 130-143(1975).

The effect of molecular motion on electron-electron double resonance (ELDOR) spectra was studied using the CH_2COO^- radical in irradiated zinc acetate. Under conditions where the product of the frequency difference ($\Delta\omega$) between two coalescing lines and the correlation time (tau) approximately equals 2 (Δtau approximately equal to 2), the motion in the radical causes a portion of the ELDOR spectrum to broaden and disappear. This effect may be used to interpret complicated ESR spectra which result from overlapping lines of several radicals in the same sample. This was illustrated using irradiated glycine which contains the radicals $NH_3^+CHCOO^-$ and CH_2COO^-. Using the ELDOR technique the hyperfine splittings of these overlapped spectra could be accurately measured at any temperature and the transition from nonequivalent protons at low temperatures to complete equivalence at higher temperatures could be followed.

39931 Ultratrace analyses by optical emission spectroscopy: the stray light problem. Larson, G.F.; Fassel, V.A.; Winge, R.K.; Kniseley, R.N. (Ames Lab., IA). *Appl. Spectrosc.;* **30**: No. 4, 384-391(1976).

When atomic emission spectroscopy is employed for the determination of trace elements at concentrations near the detection limit, the spectral background will normally be a large fraction of the total measured signal. Precise background corrections are therefore required if accurate analyses are to be achieved. Experimental evidence is presented to document the fact that stray light may produce substantial shifts in the background signal measured with some spectrometers when the total composition of the sample changes. The data presented have been obtained with the inductively coupled plasma as an excitation source; similar effects can be expected with other excitation sources as well. Examples of various forms of stray light originating from grating defects (ghosts, near and far scatter) and defects in the design of spectrometers are presented. Various methods for the reduction, elimination or correction of stray light effects are also discussed.

39932 Rapid major element mine dust analyzer. Rhodes, J.R.; Taylor, M.C. pp 92-151 of In Coal. II. Current advances in coal chemistry and mining techniques. New York; MSS Information Corporation (1976).

The objective of this project was to investigate the feasibility of analytical techniques potentially capable of determination of Mg, Al, Si, S, Ca, and Fe in 1 to 2 mg samples of respirable coal mine dust, in a total analysis time of not more than 10 minutes per sample, using equipment capable of being truck-mounted for field-laboratory operation. It was not essential that the technique be nondestructive, but the chosen technique is, and this enables the analysis to be performed directly on the 37 mm diameter membrane filter on which the respirable dust sample is normally collected. A further objective was to rule out unequivocally all candidate techniques that appeared unfeasible or unnecessarily complicated. This was done by a combination of paper and experimental studies. Seven methods in all were studied, all instrumental. The chosen technique is the simplest that satisfies the specification. It is energy dispersive x-ray fluorescence spectrometry with x-ray excitation by radioisotope tritium-titanium ($^3H/Ti$) bremsstrahlung sources. The back-up method recommended is again energy dispersive x-ray spectrometry using a small x-ray tube for excitation. A second feasible back-up technique is electron-excited x-ray spectrometry. A commercially available instrument uses an electron gun and wavelength dispersive spectrometer. Its price and complexity are midway between those of an energy dispersive x-ray tube excited x-ray fluorescence spectrometer and a conventional wavelength and dispersive x-ray fluorescence spectrometer. The main features of the recommended instrument specifications are outlined.

39933 Inexpensive high-speed dentist drill light chopper and its use in rejecting luminescence background from Raman spectra. Nemanich, R.J.; Solin, S.A.; Doehler, J. (Univ. of Chicago). *Rev. Sci. Instrum.;* **47**: No. 6, 741-744(Jun 1976).

An inexpensive dentist drill laser beam chopper is described. The chopper, which can be tuned for a chopping frequency from 100 Hz to 400 kHz, is compact, stable, and easily constructed. The usefulness of the dentist drill laser beam chopper is demonstrated in a technique for the suppression of luminescence background in Raman spectra. The technique is shown to be capable of almost complete suppression of luminescence with decay lifetimes greater than 10^{-6}

suppression of luminescence with decay lifetimes greater than 10^{-6} sec.

39934 Resonance ionization for analytical spectroscopy. Hurst, G.S.; Payne, M.G.; Wagner, E.B. (to Energy Research and Development Administration). US Patent 3,987,302. 19 Oct 1976. Filed date 27 Aug 1975. 8p.

PAT-APPL-608,377.

This invention relates to a method for the sensitive and selective analysis of an atomic or molecular component of a gas. According to this method, the desired neutral component is ionized by one or more resonance photon absorptions, and the resultant ions are measured in a sensitive counter. Numerous energy pathways are described for accomplishing the ionization including the use of one or two tunable pulsed dye lasers. 10 claims, 6 figures.

39935 Proton—electron hyperfine coupling constants of the chlorophyll a cation radical by ENDOR spectroscopy. Scheer, H.; Katz, J.J.; Norris, J.R. (Argonne National Lab., IL). *J. Am. Chem. Soc.;* **99**: No. 5, 1372-1381(2 Mar 1977).

In this paper we describe the assignment of the major coupling constants in monomer chlorophyll a cation free radical by ENDOR spectroscopy. To facilitate chemical manipulation methylpyrochlorophyllide a has been used as a stand-in, and a suite of six selectively deuterated derivatives have been subjected to ENDOR investigation. Details of the synthesis of these compounds are described. To study the effect of structural features on the spin distribution in the free radicals, six additional chlorophyll derivatives have been studied. Five coupling constants have been assigned, which account for about 80 percent of the observed electron spin resonance line width in the chlorophyll a monomer cation radical. The spin distribution appears to be highly asymmetric.

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 39095, 39256, 40110, 40136

39936 (ORNL/MIT—238) **Adsorption of polynuclear and monocyclic aromatic hydrocarbons on suspended yeast cells.** Tao, B.Y.; Dershowitz, D.J.; Troiano, R.A. (Oak Ridge National Lab., Tenn. (USA); Massachusetts Inst. of Tech., Oak Ridge, Tenn. (USA). School of Chemical Engineering Practice). 1 Oct 1976. Contract W-7405-ENG-26. 41p. P 03/MF A01.

The adsorption of anthracene on yeast cells in the presence of aniline, benzene, or toluene was examined in water at 5, 20, and 35°C. The concentration of anthracene varied from 10 to 50 μg/liter and the concentration of monocyclic aromatic hydrocarbons from 10 to 50 mg/liter. The yeast cell concentration was constant at 10 mg/liter. Equilibrium was reached within one hour for all cases. An enthalpy of adsorption of approximately 2.5 kcal/mole was calculated for anthracene.

39937 Separation of polycyclic aromatic hydrocarbons by liquid chromatography on cross-linked polyvinylpyrrolidone. Goldstein, G. (Oak Ridge National Lab., TN). *J. Chromatogr.;* **129**: 61-72(1976).

Polycyclic aromatic hydrocarbons (PAHs) can be separated by liquid chromatography on cross-linked polyvinylpyrrolidone (PVP) stationary phase using a polar solvent as eluent. The order of elution is determined primarily by the number of condensed aromatic rings. Efficient separations were obtained with a column packed with 63-90 μm particles of PVP and isopropanol as eluent. Capacity factors (k') ranged from 0.3 to 10 for PAHs having from one to five aromatic rings, and theoretical plate heights were between 0.3 and 0.5 mm. This technique is being used to assist in the characterization of products from coal liquefaction processes.

39938 Gradient-elution ion exchange chromatography: a digital computer solution of the mathematical model. Pitt, W.W. Jr. (Oak Ridge National Lab., TN). *J. Chromatogr. Sci.;* **14**: 396-404(Aug 1976).

The performance of any chromatographic system is based on the separation between adjacent sample components, and the spreading (dilution) of each component as it passes through the column. In elution chromatography, both of these characteristics are affected by the strength of the eluent and, hence, depend on the properties of the gradient in gradient-elution chromatography. To elucidate the effect of the gradient in ion exchange chromatography, a method for numerically solving a mathematical model of gradient-elution chromatography of multicomponent mixtures was developed which permitted a detailed study of the effects of varying the gradient. The model was based on the overall material balance and assumed first-order transfer rates between phases for each component. The effects of gradient changes and other parameters on elution volume and resolution could be studied independently by using this model whereas it would be very difficult and time consuming to do this experimentally. Examples of model-predicted chromatograms for various parameter changes are shown. A simplified model that predicts only elution position is also presented.

39939 Ferric ion as a scavenging agent in a solvent extraction process. Bruns, L.E.; Martin, E.C. (to Energy Research and Development Administration). US Patent 3,987,145. 19 Oct 1976. Filed date 15 May 1975. 8p.

PAT-APPL-577,821.

Ferric ions are added into the aqueous feed of a plutonium scrap recovery process that employs a tributyl phosphate extractant. Radiolytic degradation products of tributyl phosphate such as dibutyl phosphate form a solid precipitate with iron and are removed from the extraction stages via the waste stream. Consequently, the solvent extraction characteristics are improved, particularly in respect to minimizing the formation of nonstrippable plutonium complexes in the stripping stages. The method is expected to be also applicable to the partitioning of plutonium and uranium in a scrap recovery process. 7 claims, 1 figure.

39940 Flotation process for removal of precipitates from electrochemical chromate reduction unit. DeMonbrun, J.R.; Schmitt, C.R.; Williams, E.H. (to Energy Research and Development Administration). US Patent 3,989,608. 2 Nov 1976. Filed date 30 Dec 1975. 6p.

PAT-APPL-645,167.

This invention is an improved form of a conventional electrochemical process for removing hexavalent chromium or other metal-ion contaminants from cooling-tower blowdown water. In the conventional process, the contaminant is reduced and precipitated at an iron anode, thus forming a mixed precipitate of iron and chromium hydroxides, while hydrogen being evolved copiously at a cathode is vented from the electrochemical cell. In the conventional process, subsequent separation of the fine precipitate has proved to be difficult and inefficient. In accordance with this invention, the electrochemical operation is conducted in a novel manner permitting a much more efficient and less expensive precipitate-recovery operation. That is, the electrochemical operation is conducted under an evolved-hydrogen partial pressure exceeding atmospheric pressure. As a result, most of the evolved hydrogen is entrained as bubbles in the blowdown in the cell. The resulting hydrogen-rich blowdown is introduced to a vented chamber, where the entrained hydrogen combines with the precipitate to form a froth which can be separated by conventional techniques. In addition to the hydrogen, two materials present in most blowdown act as flotation promoters for the precipitate. These are (1) air, with which the blowdown water becomes saturated in the course of normal cooling-tower operation, and (2) surfactants which commonly are added to cooling-tower recirculating-water systems to inhibit the growth of certain organisms or prevent the deposition of insoluble particulates. 8 claims, 1 figure.

39941 Plutonium and americium separation from salts. Hagan, P.G.; Miner, F.J. (to Energy Research and Development Administration). US Patent 3,996,331. 7 Dec 1976. Filed date 24 Jun 1975. 8p.

PAT-APPL-589,808.

Salts or materials containing plutonium and americium are dissolved in hydrochloric acid, heated, and contacted with an alkali metal carbonate solution to precipitate plutonium and americium carbonates which are thereafter readily separable from the solution.

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 39058, 39276, 39648, 39967, 39969, 39970, 39972, 39977

39942 (Y—2071) **Properties of thermally contracting tantalum tungstates.** Holcombe, C.E. Jr.; Smith, D.D.; Richards, H.L.; Lore, J.D. (Oak Ridge Y-12 Plant, Tenn. (USA)). 22 Feb 1977. Contract W-7405-ENG-26. 35p. P 03/MF A01.

An investigation of the properties of three high-purity (greater than 99 wt percent) tantalum tungstates ($Ta_{22}W_4O_{67}$, Ta_2WO_8 and $Ta_{16}W_{18}O_{94}$) included a determination of their: densities (both bulk and theoretical), refined lattice constants, maximum-use temperatures, microhardness, heat capacities, thermal expansions (contraction) and diffusivities, calculated thermal conductivities, and electrical resistivities. A proposed mechanism showed that thermal contraction can result from an effective tilt (expansion) of the distorted oxygen coordination polyhedra into channels within the structures. Hysteresis in the thermal contraction curves can be accounted for, primarily, by a plastic deformation component (resulting from thermal stresses at the polycrystalline grain-boundary contact points) added to the elastic lattice strains.

39943 (UCRL-Trans—11229) **Natural ortho-para conversion in H_2 and D_2 in the liquid and solid phase.** Milenko, Yu.Ya.; Sibileva, R.M. Translated from *Ukr. Fiz. Zh. (Russ. Ed.);* **19**: No. 12, 2008-2014(1974). 13p. P 02/MF A01.

The rate of the o-p conversion in the liquid and solid phases of hydrogen and deuterium was measured in the concentration range

65-95 percent o-H_2 and 20-90 percent p-D_2. Hydrogen was at a saturated vapor pressure at temperatures of 20.4, 14.2, 13.7, and 4.2°K, and deuterium, at 20.4 and 4.2°K. There is a significant discrepancy between the results of this paper and the theoretical calculation of o-p conversion rate in solid deuterium, but good agreement between experimental and theoretical data exists for the o-p conversion in solid hydrogen. Explanations are given. (LK)

39944 (UCRL-Trans—11222) **Electrical resistivity of molten carbonate electrolytes thickened with lithium alumosilicates. Part I. Electrolytes with a ternary eutectic mixture of lithium, sodium, and potassium carbonates.** Burmakin, E.I.; Rodigina, E.N.; Esina, N.O. Translated from *Tr. Inst. Elektrokhim., Ural. Nauchn. Tsentr, Akad. Nauk SSSR;* No. 21, 81-84(1974). 9p. P 02/MF A01.

The electrical resistivity of a ternary eutectic mixture of lithium, sodium and potassium carbonates thickened with lithium alumosilicates was studied in the temperature range 300 to 650°C. The investigated thickening agent, in contrast to those used earlier, is a cation conductor with lithium ion conductivity. During preparation of the electrolyte there is interaction between the carbonate melt and the thickening agent, leading to an increase in the electrical resistivity of the thickening agent. The electrical resistivity of the electrolytes studied in the present work is lower than that of mixtures based on magnesium oxide, which is explained by the contribution made by the conductivity of the thickening agent toward the conductivity of the systems in question.

39945 **Synthesis of stable homopolyatomic anions of antimony, bismuth, tin, and lead. The crystal structure of a salt containing the heptaantimonide(3-) anion.** Corbett, J.D.; Adolphson, D.G.; Merryman, D.J.; Edwards, P.A.; Armatis, F.J. (Ames Lab., Iowa). *J. Am. Chem. Soc.;* **97**: 6267-6268(1975).

A solution of crypt in en was used to react with the appropriate alloy phase to yield a highly colored solution from which the crystalline homopolyatomic derivative could be isolated. The strong complexing ability of 2,2,2-crypt for the cation prevents the usual decomposition reactions. X-ray analysis provided crystal structure data for the polyantimony derivative. (DDA)

39946 **Energies and chemical shifts of the sulfur 1s level and the $KL_2L_3(^1D_2)$ Auger line in H_2S, SO_2, and SF_6.** Keski-Rahkonen, O. (Helsinki Univ. of Tech.); Krause, M.O. *J. Electron Spectrosc. Relat. Phenom.;* **9**: 371-380(1976).

The sulfur 1s binding energies and $KL_2L_3(^1D_2)$ Auger energies have been measured in gaseous H_2S, SO_2 and SF_6. The experimental data, including the chemical shifts, are compared with various theoretical ab initio results. Theoretical and experimental values agree within 1—2 eV for the chemical shift and the binding energy of the 1s level, provided in the latter case relaxation, relativistic and correlation corrections are applied. Likewise, Shirley's method, which uses empirical energies, predicts the Auger energies satisfactorily. The measured S 1s binding energies are 2478.5(1) eV, 2483.7(1) eV and 2490.1(1) eV, and $KL_2L_3(^1D_2)$ Auger energies are 2098.7(1) eV, 2095.5(2) eV, 2092.6(1) eV for H_2S, SO_2 and SF_6, respectively. The chemical shift for the 1s electron is found to be greater than for the 2s or 2p electron and in better accord with the prediction of the potential model. Data suggest the molecular relaxation energy to be small compared with the atomic relaxation energy.

39947 **Raman spectrum and molecular parameters of $^{18}O_2$.** Harney, R.C.; Milanovich, F.P. (Univ. of California, Livermore). *Can. J. Spectrosc.;* **21**: No. 6, 162-165(1976).

Medium-resolution (0.3-1.0 cm^{-1}) pure rotational and rotation-vibration Raman spectra have been obtained for a sample of 95 percent-enriched $^{18}O_2$ gas. Analysis of these spectra yielded B_0, α/sub e/ and ΔG/sub $1/_2$/ from which B/sub e/, I/sub e/ and r/sub e/ were determined. These values, which represent the first experimental determinations from Raman measurements, are in excellent agreement with those from microwave data and with theoretical predictions based on isotopic mass considerations.

39948 **Photoelectron spectroscopic studies of the adsorption of CO and CO_2 on nickel, platinum, and copper.** Norton, P.R.; Tapping, R.L. (Atomic Energy of Canada Ltd., Chalk River, Ontario). *Chem. Phys. Lett.;* **38**: No. 2, 207-212(1 Mar 1976).

The adsorption of CO and CO_2 on platinum, nickel and copper was studied by X-ray and UV photoelectron spectroscopy. The results indicate that CO_2 is physisorbed on platinum and copper and that the bonding of CO on all three metals involves the metal d-electrons and particularly the 5 sigma level of CO. It is suggested that the energy required to promote a copper d-electron to an unfilled level above the Fermi energy is responsible for the small heat of adsorption of CO on copper.

39949 **Method of preparing pure fluorine gas.** Asprey, L.B. (to Energy Research and Development Administration). US Patent 3,989,808. 2 Nov 1976. Filed date 28 Jul 1975. 4p.
PAT-APPL-599,443.

A simple, inexpensive system for purifying and storing pure fluorine is described. The method utilizes alkali metal-nickel fluorides to absorb tank fluorine by forming nickel complex salts and leaving the gaseous impurities which are pumped away. The complex nickel fluoride is then heated to evolve back pure gaseous fluorine.

39950 **Decomposition equilibria of platinum di- and mono-chlorides by the simultaneous torque-Knudsen technique.** O'Brien, W.G.; Jensen, H.J.; Benedict, R.N.; Bautista, R.G. *Metall. Trans., B;* **7**: 671-677(Dec 1976).

The decomposition equilibria of platinum dichloride have been found to consist of two decomposition steps, with chlorine molecules being the vapor species for both steps. An intermediate metastable PtCl solid is formed in the first step in addition to platinum metal and chlorine molecules. The platinum dichloride decomposes incongruently, the stepwise decomposition being $PtCl_2$ yields PtCl yields Pt. The $PtCl_2$ decomposition reactions consist of $PtCl_2(s) = PtCl$ (metastable s) + 1/2 $Cl_2(g)$ and $PtCl_2(s) = Pt(s) + Cl_2(g)$. The sum of the third law ΔH/sub D,298 K/ for the above two reactions is 214.637 +- 1.963 kJ/mole, in very good agreement with the second law ΔH/sub D,298 K/ = 215.107 +- 13.062 kJ/mole. The second decomposition step is given by the reaction 2PtCl (metastable s) = 2Pt(s) + $Cl_2(g)$ with a third law ΔH/D,298 K/ = 127.356 +- 0.791 kJ/mole, in excellent agreement with the second law ΔH/D,298 K/ = 127.509 +- 6.154 kJ/mole. The calculated heat of formation of $PtCl_2$ is —139 +- 2 kJ/mole and that of PtCl is —63 +- 1 kJ/mole.

39951 **Normal spectral emittance of yttrium, lanthanum, cerium, praseodymium, and neodymium above 1000°K.** Baria, D.N.; King, T.S.; Bautista, R.G. *Metall. Trans., B;* **7**: 577-588(Dec 1976).

The normal spectral emittance (lambda = 0.645 μm) of yttrium, lanthanum, cerium, praseodymium and neodymium was determined at temperatures above 1000 K in an argon atmosphere at a pressure slightly above atmospheric. The measured normal spectral emittances are: yttrium, (solid), epsilon/sub n lambda/ = 0.368 +- 0.005; (liquid), epsilon/sub n lambda/ = 0.368 +- 0.005; lanthanum, (solid), epsilon/sub n lambda/ = 0.409 +- 0.049; (liquid), epsilon/sub n lambda/ = 0.257 +- 0.015; cerium, (liquid), epsilon/sub n lambda/ = 0.309 +- 0.020; praseodymium, (solid), epsilon/sub n lambda/ = 1.609 — 1.0964 x 10^{-3} T (K); (liquid), epsilon/sub n lambda/ = 0.284 +- 0.005; neodymium, (solid), epsilon/sub n lambda/ = 1.090 — 5.6 x 10^{-4} T (K); (liquid), epsilon/sub n lambda/ = 0.394 +- 0.007.

39952 **Synthesis and crystal structure of a salt containing the tritelluride(2-) anion.** Cisar, A.; Corbett, J.D. (Ames Lab., Iowa). *Inorg. Chem.;* **16**: No. 3, 632-635(Mar 1977).

The deep red compound [(4,7,13,16,21,24-hexaoxa-1,10-diazabicyclo[8.8.8]hexacosane)potassium] tritelluride(2-)-ethylenediamine, $(C_{18}H_{36}N_2O_6K^+)_2Te_3^{2-}$.en, has been prepared by the reaction of a solution of K_2Te and the ligand (2,2,2-crypt) in ethylenediamine with an excess of elemental tellurium. The compound crystallizes in the trigonal space group $P3_2$ (C_3^2, No. 145) with lattice constants a = 12.229 (1) and c = 31.242 (4) A and three molecules per unit cell. Three-dimensional x-ray data were collected on an automated diffractometer using monochromated Mo Kα radiation. The structure was deduced by conventional heavy-atom techniques, and the positional and thermal parameters of the 61 independent nonhydrogen atoms were refined by full-matrix least squares using 2033 unique observed (I greater than 3sigma/sub I/) reflections to R = 0.094, R/sub w/ = 0.103. The Te_3^{2-} ion exhibits bond lengths of 2.692 (5) and 2.720 (4) A and an angle of 113.1 (2)°. The slight deviation of Te_3^{2-} from C/sub 2upsilon/ symmetry together with different thermal parameters for its terminal atoms evidently arise from hydrogen bonding to the ethylenediamine molecule. d/sub Te-N/ = 3.46 (6) A. The anion parameters are compared with those of related ions and the element.

39953 **Structural studies of precursor and partially oxidized conducting complexes. VIII. A neutron diffraction investigation of rubidium tetracyanoplatinate (2:1) sesquihydrate, $Rb_2[Pt(CN)_4].1.5H_2O$.** Koch, T.R.; Johnson, P.L.; Williams, J.M. (Argonne National Lab., IL). *Inorg. Chem.;* **16**: No. 3, 640-645(Mar 1977).

The crystal and molecular structure of rubidium tetracyanoplatinate (2:1) sesquihydrate, $Rb_2[Pt(CN)_4] \cdot 1.5H_2O$(RbTCP), has been determined by a single-crystal neutron-diffraction study. The compound RbTCP crystallizes with eight formula units in the space group C/sub 2h/^{6}-C2/c with monoclinic cell dimensions a = 12.693 (8) A, b = 12.809 (8) A, c = 13.642 (9) A, and β = 112.22 (4)°. The centrosymmetric space group C2/c was verified by a very satisfactory least-squares refinement. A total of 4108 reflections was averaged to yield 2875 independent reflections (2417 with F_o^2 greater than 1sigmaF_o^2). The structure solved by direct methods and refinement, using full-matrix least-squares techniques, has produced a final $R(F_o^2)$ value of 0.068 using all data. The structure consists of a bent Pt metal atom chain [bond angle 170.97 (4)°] in which the asymmetric unit contains two crystallographically distinct $Pt(CN)_4^{2-}$ groups,

two Rb^+ ions, and two H_2O molecules (one O and one H atom are in disorder). An inversion center occurs at Pt(1), and a twofold rotation axis is present along the b axis of the cell (on which Pt(2) lies). While Pt(1) resides on the c axis, Pt(2) is displaced 0.270 (1) A normal to c. This bent Pt-Pt chain appears to result from an asymmetric electrostatic environment about Pt(2) involving Rb^+.../sup delta-/N identical with C interactions. The role of Rb^+ ion coordination and hydrogen bonding in this structure is discussed. The importance of RbTCP as a precursor in the formation of partially oxidized tetracyanoplatinate (POTCP) complexes is presented in a discussion of POTCP complexes of rubidium.

39954 Structural studies of precursor and partially oxidized conducting complexes. IX. The new one-dimensional tetracyanoplatinates, $M_2[Pt(CN)_4](FHF)_{0.39}.xH_2O$ (M = Rb, Cs), and a new lower limit for the platinum—platinum separation (2.80 A). Williams, J.M.; Gerrity, D.P.; Schultz, A.J. (Argonne National Lab., IL). *J. Am. Chem. Soc.;* **99**: No. 5, 1668-1669(2 Mar 1977).

In an attempt to increase interchain coupling, the new anion-deficient fluorine-containing salts $K_2[Pt(CN)_4](FHF)_{0.30} . xH_2O$ and $M_2[Pt(CN)_4] (FHF)_{0.39} . xH_2O$, where M = Rb or Cs, were prepared. Details regarding the preparation and characterization of $Cs[Pt(CN)_4] (FHF)_{0.39} . xH_2O$ are presented. The Cs and Rb complexes contain the shortest intrachain Pt-Pt separations (2.832 (1) and 2.798 (1) A, respectively) yet observed in partially oxidized tetracyanoplatinate salts.

39955 X-ray and neutron diffraction studies on $H_3Nb(C_6H_5)_2$ and $H_3Ta(C_6H_5)_2$. Wilson, R.D.; Koetzle, T.F.; Hart, D.W.; Kvick, A.; Tipton, D.L.; Bau, R. (Univ. of Southern California, Los Angeles). *J. Am. Chem. Soc.;* **99**: No. 6, 1775-1781(16 Mar 1977).

The molecular structures of $H_3Nb(C_6H_5)_2$ and $H_3Ta(C_6H_5)_2$ have been analyzed by x-ray and neutron diffraction techniques, respectively. In both compounds the central H_3M fragment is planar within experimental error and defines a noncrystallographic mirror plane for the molecule. The three hydridic atoms are essentially equidistant from the metal atom and are arranged with the central M—H bond in a bisecting position. From the x-ray diffraction analysis of $H_3Nb(C_6H_5)_2$, Nb-H = 1.65 (6), 1.65 (6), and 1.76 (7) A, and H-Nb-H = 65 (3) and 61 (3)°. More accurate distances and angles were obtained from the neutron diffraction analysis of $H_3Ta(C_6H_5)_2$: Ta-H = 1.769 (8), 1.775 (9) A; H-Ta-H = 62.8 (5) and 63.0 (4)°. Other important molecular parameters are as follows: for $H_3Nb(C_6H_5)_2$, Nb-ring (centroid) = 2.059 A, Nb-C (av) = 2.375 A, ring-Nb-ring bending angle = 141.6°; for $H_3Ta(C_6H_5)_2$, Ta-ring = 2.065 A, Ta-C(av) = 2.393 A, ring-Ta-ring bending angle = 139.9°. The structure of the isoelectronic compound $[H_3W(C_6H_5)_2]^+Cl^-$ has also been examined, and found to be similar to that of $H_3Nb(C_6H_5)_2$ and $H_3Ta(C_6H_5)_2$. Final agreement factors (based on F) for data with I greater than 3 sigma:in $H_3Nb(C_6H_5)_2$, R/sub F/ = 0.035 and R/sub wF/ = 0.043 for 1530 reflections (x-ray data collected at room temperature); in $H_3Ta(C_6H_5)_2$, R/sub F/ = 0.069 and R/sub wF/ = 0.051 for 841 reflections (neutron data collected at 90 K).

39956 Thermodynamics of the lithium—lithium deuteride system. Veleckis, E. (Argonne National Lab., IL). *J. Phys. Chem.;* **81**: No. 6, 526-531(24 Mar 1977).

Pressure-composition-temperature data were collected for the Li—LiD system in the ranges 0 to 750 Torr, 1 to 99 mol percent LiD, and 705 to 871°C by measuring equilibrium deuterium pressures over encapsulated Li—LiD mixtures. The data yielded a family of five P/sub D_2//sup ½/ vs. N/sub LiD/ isotherms whose shapes indicate the existence of two homogeneous terminal solutions that are separated by a wide miscibility gap. Beginning at the consolute point (1000 +- 10°C, 61 +- 3 mol percent LiD), the gap widens to a range of 21.3 to 99.0 mol percent LiD at the monotectic temperature (689°C). The mole-fraction solubility at the Li-rich gap boundary and plateau pressures above and below the monotectic temperature may be represented by N'/sub LiD/(satd) = exp(2.604 — $3992T^{-1}$), P/sub P1,l/(Torr) = exp (21.21 — $16940T^{-1}$), and P/sub P1,s/(Torr) = exp(28.04 — $23510T^{-1}$), respectively. The data yielded the equilibrium constant [K(atm/sup -½/) = exp(-6.630 + $7995T^{-1}$)] for the reaction Li(soln) + ½D_2(g) reversible LiD(soln) and expressions for the chemical potentials and activity coefficients of each species as functions of temperature and composition. Activity coefficients, evaluated at N/sub LiD/ yields 0 and N/sub Li/ yields 0, were combined with the equilibrium constant to generate temperature-dependence equations for various constants associated with dilute solutions. For the Li-rich limit, the Sieverts' constant [K' = N/sub LiD//(P/sub D_2/)/sup ½/] is given by K'(mol fraction LiD/atm/sup ½/) = exp(-6.138 + $5599T^{-1}$). Advantages of the Ostwald coefficient in describing the distribution of the dissolved species between liquid and gas phase are discussed.

39957 Carbon-13 NMR of carbon monoxide. I. Pressure dependence of translational motion in β-CO . Fukushima, E.; Gibson, A.A.V.; Scott, T.A. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **66**: No. 11, 4811-4817(1 Jun 1977).

Activation parameters for self-diffusion of carbon monoxide molecules have been studied in the hexagonal beta phase of CO as a function of pressure and temperature. The carbon-13 nuclear transverse relaxation time T_2, which is proportional to the average molecular jump rate tau^{-1}, was measured by the Carr—Purcell Meiboom—Gill method. The activation enthalpy increases from 13 to 16 kJ/mole between 0 and 1.75 kbar and the activation volume is 44 +- 5 cm^3/mole, which corresponds to 1.5 molar volumes. The results indicate a single diffusion mechanism in this P—T range; most probably the diffusion takes place by migration of monovacancies.

39958 Variable temperature ^{31}P and ^{19}F NMR studies of $Fe(CO)_3(PF_3)_2$ and $Fe(CO)_2(PF_3)_3$. Mahnke, H.; Clark, R.J.; Sheline, R.K. (Department of Chemistry, Florida State University, Tallahassee, Florida 32306). *J. Chem. Phys.;* **66**: No. 11, 4822-4826(1 Jun 1977).

^{31}P and ^{19}F NMR spectra for the compounds $Fe(CO)_3(PF_3)_2$ and $Fe(CO)_2(PF_3)_3$ were studied in the temperature range +25 degreeC down to -100 degreeC. The four spin—spin coupling constants ^1J/sub PF/, ^3J/sub PFprime/, ^2J/sub PPprime/, and ^4J/sub FFprime/ were evaluated as a function of temperature. Owing to the fast intramolecular exchange of axial with equatorial ligand groups in these compounds, the observed spectra are time-averaged. The magnitude of the observed time-averaged ^2J/sub PPprime/ coupling constant can be accounted for by the experimentally determined mole fractions for the various isomers and the trans, cis and vicinal phosphorus—phosphorus coupling constants ^2J/sup t r a n s//sub PPprime/, ^2J/sup c i s//sub PPprime/ and ^2J/sup v i c i n a l//sub PPprime/, respectively. An angular correlation of the phosphorus—phosphorus coupling constant is attempted. These results are compared to variable temperature ir and ^{13}C NMR studies of these compounds. The usefulness of studying ir or Raman spectra in addition to the NMR spectra for certain nonrigid molecules which fall in the "very fast exchange" category where no temperature coalescence of NMR spectral lines can be observed, is demonstrated. The simultaneous fitting of both the time-averaged NMR spectra on the one hand and the separate ir spectra on the other is the best way to study such molecules. 151

39959 High frequency sound velocity and sound absorption in supercooled water and the thermodynamic singularity at 228degreeK. Rouch, J.; Lai, C.C.; Chen, S. (Nuclear Engineering Department, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *J. Chem. Phys.;* **66**: No. 11, 5031-5034(1 Jun 1977).

The interpretation of our experimental results on the high frequency sound velocity and sound absorption in liquid and supercooled liquid water lends support to the existence of a thermodynamic singularity at about 228degreeK. We determine the respective critical exponents and find them in good agreement with those, whenever available, deduced from other techniques.

39960 Studies of Rydberg state reactions. Klots, C.E. (Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Chem. Phys.;* **66**: No. 11, 5240-5241(1 Jun 1977).

The reaction mechanisms of high Rydberg and metastable states of He are studied by mass spectroscopy. It is concluded that the former type of reaction is basically a charge-transfer type dictated by the initial electron attachment.(AIP)

39961 Operator formalism for double quantum NMR. Vega, S.; Pines, A. (Department of Chemistry and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *J. Chem. Phys.;* **66**: No. 12, 5624-5644(15 Jun 1977).

An operator formalism is presented which conveniently treats the interaction of a spin-1 nucleus with a weak radio frequency field. The Hamiltonian in the rotating frame is $H=-\Delta\omega$ I/sub z/-ω_1I/sub x/+(1/3) ω/sub Q/[3 I^2/sub z/-I (I+1)], where $\Delta\omega$ is the resonance offset ($\Delta\omega=\omega_0-\omega$), ω_1 is the intensity of the rf field, and ω/sub Q/ is the quadrupolar splitting. Nine fictitious spin-1/2 operators, I/sub p , i/ where p=x,y,z and i=1,2,3, are defined where p refers to the transition between two of the levels and i the Cartesian component. The operators, which are the generators of the group SU (3), satisfy spin-1/2 commutation relations [I/sub p , j/, I/sub p , k/]=i I/sub p , l/, where j,k,l=1,2,3 or cyclic permutation. Thus each p defines a three-dimensional space termed p space. For irradiation near one of the quadrupolar satellites, for example, $\Delta\omega=\omega$/sub Q/+$\delta\omega$ with $\delta\omega$, $\omega_1$very-much-less-thanω/sub Q/, it is shown that the effective Hamiltonian can be written $H-\delta\omega$I/sub x ,/$_3-\sqrt{2}$ ω_1I/sub x ,/$_1$, i.e., a fictitious spin-1/2 Hamiltonian in x space with effective magnetogyric ratio γ along the 3 (resonance offset) axis and $\sqrt{2}\gamma$ along the 1 (rf field) axis. For irradiation near the center we can effect double quantum transitions between m= +- 1. The formalism allows us to write the effective operators for these transitions. The limiting expressions are compared with exact calculations for arbitrary ω_1 done by high speed computer. The theory is applied to various cases of irradiation including our previously reported technique of Fourier transform double quantum NMR. Various pulse sequences for pre-

paring, storing, and maintaining the evolution of double quantum coherence are analyzed for single crystal and polycrystalline samples. Finally, the effects of rf phase on the double quantum phase are presented briefly, and the possibility of double quantum spin locking is analyzed.

ISOTOPE EFFECTS

39962 Molecular motions in compressed liquid heavy water at low temperatures. DeFries, T.; Jonas, J. (Department of Chemistry, School of Chemical Sciences and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). *J. Chem. Phys.;* **66**: No. 12, 5393-5399(15 Jun 1977).

The NMR deuteron spin—lattice relaxation times T_1, self-diffusion coefficients D, and shear viscosities eta have been measured as a function of pressure in the temperature interval -15 to 10degreeC. The low-pressure extreme of the measurements is Ice I, whereas Ice V represents the high-pressure boundary of the experiments. In analogy with anomalous motional behavior in compressed liquid water, the initial compression of liquid D_2O in the temperature interval studied results in higher motional freedom of D_2O molecules so that T_1 and D dependences with pressure exhibit a maximum and shear viscosity shows a minimum. This is a result of distortion and weakening of the hydrogen bond network owing to compression. Further compression hinders molecular motions as a result of increased repulsive interactions due to higher packing. This study also enables us to test the applicability of hydrodynamic equations at the molecular level for liquid heavy water. Analysis of the relaxation and shear viscosity data show that the Debye equation fails to describe the density effects on reorientation of D_2O molecules. It appears that the success of the Debye equation to describe temperature effects on reorientation of H_2O and D_2O molecules at 1 bar is accidental. However, the data show that the deuteron relaxation rate $(1/T_1)$/sub D/ is proportional to eta/T under isochoric conditions. The fact that the slope of the $(1/T_1)$/sub D/ vs eta/T plot diminishes with increasing density indicates that compression leads to diminished coupling between rotational and translational motions of water molecules. The shear viscosity and self-diffusion data show that the Stokes—Einstein equation does not represent the relationship between D and eta in liquid heavy water. A brief discussion of the isotope effects on shear viscosity in liquid D_2O and H_2O is presented.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 39297, 39298

39963 (COO—2961-1) **Photo-induced cataphoretic isotope separation. Progress report, June 15, 1976—June 14, 1977.** Carruthers, J.A.; Chanin, L.M.; Oskam, H.J. (Minnesota Univ., Minneapolis (USA)). Feb 1977. Contract EY-76-S-02-2961. 15p. P 02/MF A01.

Initial results of studies of the feasibility of radiation-induced cataphoretic segregation of isotopes are summarized. More detailed feasibility calculations show that significant isotope separation efficiencies can be obtained for discharges at low pressure. This may make it desirable to use a buffer gas in the discharge in order to manipulate the electron energy distribution. Requirements for the properties of the buffer gas have been established. The experimental system for studying laser-induced cataphoretic separation of neon isotopes has been completed. Preliminary studies show that the system is capable of detecting less than 1% change in the Ne^{20}/Ne^{22} isotope ratio. It is anticipated that a systematic study can be made with respect to the photo-induced isotope separation efficiency in about three months. The other experimental system relates to the separation of mercury isotopes in a direct current gaseous discharge using radiation from external monoisotopic mercury light sources. Initial experimental feasibility studies of this technique are expected to be started after about three months. The ultra-high vacuum and gas handling system has been completed.

39964 (LA-UR—75-1865) **Multiple photon isotope separation.** Lyman, J.L.; Rockwood, S.D. (Los Alamos Scientific Lab., N.Mex. (USA)). Sep 1975. Contract W-7405-ENG-36. 16p. (CONF-751102—4). P 02/MF A01.

From International laser exposition and electro-optics '75; Anaheim, California, USA (11 Nov 1975).

Isotopically selective reactions have been induced in the molecules SF_6, BCl_3, CF_2Cl_2, and SiF_4 by absorption of intense CO_2 laser radiation. Results of recent experiments that were designed to give greater understanding of the mechanism of the reaction are reported. Experiments with four different molecules demonstrate that the effect is fairly general. For all molecules, the reaction selectivity was best at low pressures. Several more detailed experiments have been performed with SF_6 in which the effect of total pressure, partial pressure of each reactant, laser energy per pulse and pulse length on the selective reaction was determined. These results and their application to the understanding of the reaction mechanism are discussed.

39965 (LA-UR—76-974) **Infrared laser isotope separation.** Lyman, J.L.; Rockwood, S.D. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-ENG-36. 6p. (CONF-760620—4). P 02/MF A01.

From 12. informal conference on photochemistry; Gaithersburg, Maryland, United States of America (USA) (28 Jun 1976).

An evaluation of isotope separation by selective molecular dissociation using CO_2 laser radiation is presented. Results of gaseous SF_6 irradiation in cylindrical cells are tabulated. The experiments were conducted using 25 percent SF_6 in H_2 irradiated by CO_2 laser pulses at 10.6 μm. Results show enhancements in reaction yield as high as 50, corresponding to a photon utilization efficiency of 0.5 percent. (JRD)

39966 Infrared induced reactions in methanol—bromine mixtures: a negative result. Willis, C. (National Research Council of Canada, Ottawa); Back, R.A.; Corkum, R.; McAlpine, R.D.; McClusky, F.K. *Chem. Phys. Lett.;* **38**: No. 2, 336-340(1 Mar 1976).

Suggestions have been made that infrared induced reactions in CH_3OH—Br_2 mixtures can lead to isotope separation. A careful quantitative study has been made of limiting quantum yields of the infrared induced reactions in such mixtures and they are found to be very low, phi less than or equal to 10^{-3}, both with radiation from a laser and from a black body source.

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 39106, 39107, 39112, 39115, 39210, 39211, 39212, 39230, 39253, 39255, 39419, 39952, 39953, 39954, 39955, 39987, 39989, 39994

39967 (IS-T—746) **Synthesis of two mercaptide-substituted hexanuclear molybdenum halide clusters.** Michel, J.B. (Ames Lab., Iowa (USA)). Mar 1977. Contract W-7405-ENG-82. 55p. P 04/MF A01. Thesis.

Two new derivatives of the $[(Mo_6Cl_8)Cl_4]$ cluster have been prepared. $Na_2[(Mo_6Cl_8)(SC_2H_5)_6]$. $3(C_5H_5N)$ was made by first reacting molybdenum dichloride with sodium ethyl mercaptide (1:6 mole ratio) in refluxing methanol. The orange product was recovered in pure crystalline form by extraction of the solid residue with pyridine. This compound was characterized by its X-ray powder pattern, elemental analysis, and infrared and electronic spectra. It dissolves in most polar solvents, yielding reddish-orange solutions. Treatment of alcohol solutions with hydrochloric acid causes rapid conversion to $[(Mo_6Cl_8)Cl_6]^{2-}$, accompanied by the evolution of ethyl mercaptan. $[(Mo_6Cl_8)(SC_2H_5)_4(C_5H_5N)_2]$ was prepared using the same procedure, starting with a 1:4 mole ratio of molybdenum dichloride and sodium ethyl mercaptide. This material was isolated as a red, amorphous solid. It was characterized by elemental analysis and infrared and electronic spectra. It is soluble in pyridine, DMSO, and DMF; other polar solvents must be acidified before it will dissolve. Treatment of this compound with a solution of concentrated hydrochloric acid in methanol again yielded $[(Mo_6Cl_8)Cl_6]^{2-}$. Its amorphism and insolubility in most polar solvents suggest this compound might be polymeric. Individual cluster units are probably linked in a random way by intercluster mercaptide bridges. More extensive characterization of this compound in its solid state is required to confirm this.

39968 Basicities and ion-molecule reactions of the methylphosphines in the gas phase by ion cyclotron resonance spectroscopy. Staley, R.H.; Beauchamp, J.L. (California Inst. of Tech., Pasadena). Contract AT(04-3)767-8. *J. Am. Chem. Soc.;* **96**: No. 20, 6252-6259(2 Oct 1974).

The gas phase ion chemistry of the methylphosphines, (CH_3)/sub n/PH/sub 3-n/ (n = 1-3), has been investigated using ion cyclotron resonance spectroscopy. Reaction pathways, product distributions, and rate constant have been determined using trapped ion techniques complemented by the more usual method of examining the variation of ion abundance with pressure. Reaction of the parent ion to give protonated parent was observed for methyl- and dimethylphosphine only. Condensation reaction of the parent ion and neutral with loss of methyl radical occurs in all three phosphines. Condensation reactions of prominent fragment ions with loss of various small molecules or radicals were also studied. Values of 187.9, 206.9, 218.9, and 228.0 kcal/mole have been determined for the proton affinities of phosphine and methyl-, dimethyl-, and trimethylphosphine from investigations of proton transfer equilibria. Adiabatic ionization potentials measured by photoelectron spectroscopy are combined with these results to yield values of 104.0, 103.6, 100.7, and 99.2 kcal/mole for the respective BH^+ homolytic bond dissociation energies for the conjugate acids of the methylphosphines. Factors affecting proton affinities and homolytic bond dissociation energies are discussed in a comparison of the results for the phosphines to those for the congeneric amines. The proton affinity

results are also combined with enthalpies of protonation in HSO_3F to obtain a measure of solvation effects.

39969 Silylene additions to cyclopentadiene and 1,3-cyclohexadiene. Evidence for the addition mechanism. Hwang, R.J.; Conlin, R.T.; Gaspar, P.P. (Washington Univ., St. Louis). *J. Organomet. Chem.;* **94**: C38-C42(1975).

Additions of SiH_2, $SiCl_2$ and $Si(CH_3)_2$ to cyclopentadiene and of $Si(CH_3)_2$ to 1,3-cyclohexadiene were carried out by copyrolysis of an appropriate disilane and the diene. All observed products are believed due to 1,2-addition of silylenes forming bicyclic vinylsilacyclopropane derivatives which undergo non-concerted rearrangements.

39970 Reaction of germanium atoms with trimethylsilane. Conlin, R.T.; Lockhart, S.H.; Gaspar, P.P. (Washington Univ., St. Louis). *J. Chem. Soc. (London), Chem. Commun.;* 824-826(1975).

Co-condensation of thermally evaporated germanium vapour with trimethylsilane yields bis-trimethylsilylgermane, $Me_3SiGeH_2SiMe_3$.

39971 Sulfonation of petroleum feedstocks in a wiped film reactor. Ashcraft, T.L.; Saunders, R.K. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—43).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

This paper summarizes the yields of broad spectrum sulfonates obtained from the sulfonation of selected petroleum fractions using gaseous SO_3 in a wiped film reactor. Sulfonation is selective toward molecules having more than two aromatic rings; however, SO_3 treats well in excess of 1.0 moles SO_3/mole feed aromatics are required to achieve aromatics conversions in excess of 50-70 percent. Sulfonic acid decomposition with concomitant formation of SO_2 can significantly reduce sulfonates yield. Sulfonic acid decomposition, which can be minimized by rapid neutralization of the acid product, is an important consideration in the design of a sulfonation process.

39972 Formation of gas-phase negative ions in $Fe(CO)_5$ and $Ni(CO)_4$. Compton, R.N.; Stockdale, J.A.D. (Oak Ridge National Lab., TN). *Int. J. Mass Spectrom. Ion Phys.;* **22**: 47-55(1976).

The formation and structure of negative ions from iron and nickel carbonyl has been studied in gas-phase collision experiments using both low-energy (less than or equal to 10 eV) electrons and fast (less than or equal to 40 eV) potassium atoms as projectiles. Dissociative attachment of low-energy electrons to $Fe(CO)_5$ and $Ni(CO)_4$ occurs with a high probability to produce $Fe(CO)_4^-$ and $Ni(CO)_3^-$, respectively. Structure is found in the dissociative attachment cross section for producing $Fe(CO)_3^-$ and $Fe(CO)_2^-$ from $Fe(CO)_5$ in the energy region from 3 eV to 6 eV. This structure is attributed to predissociation from an electronically excited state of the $Fe(CO)_4^-$ ion.

39973 Synthesis, trapping, and dimerization of 9,10-benzotricyclo[3.3.2.0^{3,7}]deca-3(7),9(10)-diene. X-ray crystal structure of the dimer. Greenhouse, R. (Univ. of Washington, Seattle); Borden, W.T.; Hirotsu, K.; Clardy, J. *J. Am. Chem. Soc.;* **99**: No. 5, 1664-1666(2 Mar 1977).

Transannular reductive ring closure was used in the first successful synthesis of a member of the class of bridgehead olefins in which the carbons forming the double bonds are pyramidalized. Diphenylisobenzofuran was used as the trapping agent. The structure of the dimer, formed in absence of diphenylisobenzofuran, was studied by x-ray diffraction. (DDA)

39974 Photochemistry of 1,4-dihydronaphtho[1,8-de][1,2]diazepine. Preparation and electron spin resonance observation of the unsubstituted 1,8-naphthoquinodimethane. Pagni, R.M. (Univ. of Tennessee, Knoxville); Burnett, M.N.; Dodd, J.R. *J. Am. Chem. Soc.;* **99**: No. 6, 1972-1973(16 Mar 1977).

In an attempt to prepare selenated tRNA, transformation of 4-thiouridine to selenouridine in tRNA was attempted. Feasibility studies were performed by spectrophotometrically monitored conversion of 1 methyl-4- thiocyanatouracil to 1-methyl-4-selenouracil by NaHSe. E.coli mixed tRNA were exposed to the same sequence of reactions and the identity of the products was confirmed. (DDA)

39975 Calculation of the electronic spectra of chlorophyll a- and bacteriochlorophyll a-water adducts. Shipma, L.L.; Katz, J.J. (Argonne National Lab., IL). *J. Phys. Chem.;* **81**: No. 6, 577-581(24 Mar 1977).

Exciton calculations have been carried out for the lower-energy manifold of electronic transitions of (chlorophyll a.H_2O)/sub n/ and (bacteriochlorophyll a.H_2O)/sub n/ stacks. Most of the oscillator strength of a stack is concentrated in the lowest energy transition. The position of the lowest energy transition ranges from 693 to 721 nm for chlorophyll a hydrate stacks and from 848 to 908 nm for bacteriochlorophyll a hydrate stacks as n is varied from 2 to infinity. A comparison of the calculated spectra for chlorophyll a hydrate stacks and bacteriochlorophyll a hydrate stacks with the absorption spectra of in vivo antenna chlorophyll a and bacteriochlorophyll a, respectively, reveals that chlorophyll a hydrate stacks are probably not major components of antenna chlorophyll a in green plants and algae but that bacteriochlorophyll a hydrate stacks may be identified with the more red-shifted components of antenna bacteriochlorophyll a in purple photosynthetic bacteria.

39976 Internal rotation in the ground electronic state of allene. Dykstra, C.E. (Univ. of California, Berkeley). *J. Am. Chem. Soc.;* **99**: No. 7, 2060-2063(30 Mar 1977).

The internal rotation potential of allene has been studied with ab initio self-consistent field (SCF) methods using a double-zeta basis set of 38 contracted Gaussian functions and an extended set of 65 functions including polarization functions, and with the method self-consistent electron pairs (SCEP) using the double-zeta set. The ground state of allene is a closed shell $^1A_1$ state in D/sub 2d/ symmetry. In the D_2 symmetry of the twisted form, this closed shell state mixes with a $2b_3$ yields $3b_3$ open shell $^1A_1$ state which correlates with a ^{1}A/sub u/ state in the D/sub 2h/ symmetry of the planar form of the molecule. The planar closed shell state, ^{1}A/sub g/, is higher in energy than the ^{1}A/sub u/ state. Examination of pair correlation energies indicates that correlation effects will not reverse this order. The internal rotation barrier is predicted to be about 49 kcal, after geometry optimization, and there is little effect on relative energies from including polarization functions.

39977 Copper—cadmium N-methyltetraphenylporphyrin electrophilic substitution reaction: evidence for a cis attack. Stinson, C.; Hambright, P. (Howard Univ., Washington, DC). *J. Am. Chem. Soc.;* **99**: No. 7, 2357(30 Mar 1977).

A kinetic study of copper replacing cadmium from the Cd(II) N-methyltetraphenylporphin complex showed that added cadmium does not inhibit the reaction rate. This lack of inhibition tends to rule out a mechanism in which cadmium first dissociates before copper incorporation. As the simplest interpretation is that cadmium and copper are on the same side of the porphyrin plane during substitution, the observations imply that either or both cis and trans geometries may occur during electrophilic substitution reactions.

ISOTOPE EFFECTS

REFER ALSO TO CITATION(S) 39935

39978 Isotope effect study of triple bond participation during a homopropargyl rearrangement. Collins, C.J. (Oak Ridge National Lab., TN); Benjamin, B.M.; Hanack, M.; Stutz, H. *J. Am. Chem. Soc.;* **99**: No. 5, 1669-1670(2 Mar 1977).

Carbon 14 and deuterium isotope effects were studied for the trifluoroethanolysis of 1-pent-3-ynyl triflate to obtain estimates of timing involved with respect to the incoming and departing groups about C_1. The data indicate that the bond order for the breaking C_1—O bond is greater than that for the developing C_3—C_1 bond. The anchimeric assistance by the triple bond is, therefore, assumed to be considerable and much greater than for the neophyl case. (DDA)

39979 Aromatic protonation. XII. Solvent isotope effects in H_2O—D_2O mixtures on the detritiation of trimethoxybenzene. Kresge, A.J.; Chiang, Y.; Koeppl, G.W.; More O'Ferrall, R.A. (Illinois Inst. of Tech., Chicago). *J. Am. Chem. Soc.;* **99**: No. 7, 2245-2254(30 Mar 1977).

The problem of kinetic solvent isotope effects in H_2O—D_2O mixtures on systems for which proton transfer from H_3O^+ and some subsequent reaction step are each partly rate determining is considered, and an expression relating the isotope effect to the atom fraction of deuterium in the solvent is derived for a symmetrical isotope exchange process such as acid-catalyzed aromatic hydrogen exchange. This expression is then applied to data presented here for the detritiation of 1,3,5-trimethoxybenzene-2-t as well as to literature values for the same reaction and the detritiation of azulene-1-t. The analysis yields isotopic (Bronsted) exponents, α/sub i/ = 0.67 for trimethoxybenzene and α/sub i/ = 0.57 for azulene, which are not affected substantially by inclusion of corrections for nonadherence to the rule of the geometric mean and which are in good agreement with conventional Bronsted exponents as well as other measures of transition-state structure for these reactions.

ELECTROCHEMISTRY

REFER ALSO TO CITATION(S) 39954

39980 (LBL—6094) **Simultaneous reactions on a rotating-disk electrode.** White, R.E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1977. Contract W-7405-ENG-48. 137p. P 07/ MF A01.

Thesis.

Multiple reactions at a rotating-disk electrode are modeled for two cases. First, the governing equations, which do not include the effect of ionic migration but do include the radial dependence of the concentrations and potential, are used to generate a parameter which characterizes the effect of a side reaction on the limiting-current curve of a main reaction. Various predicted current-potential curves illustrate the importance of this parameter for copper deposition with simultaneous formation of dissolved hydrogen at a disk electrode rotating in a copper sulfate solution containing sulfuric acid. Second, deposition of copper from an aqueous solution containing cupric and ferric chloride is modeled. The potential distribution and concentration profiles within the diffusion layer are predicted for given potential differences between the electrode and the solution. A cuprous ion, which is formed by the reduction of the complexed cupric ion at the electrode, is stabilized in the chloride solution and can react either at the electrode or with ferric species within the diffusion layer. The assumptions that this homogeneous reaction is fast and irreversible generates a reaction plane, whose position is shown in the concentration and potential profiles. In addition, the position of the reaction plane is plotted as a function of the potential difference between the electrode and the adjacent solution. Predicted current-potential and current efficiency-potential curves are also reported. Finally, the iron contamination of the deposited copper is estimated to be less than 10^{-5} atom percent for some cases. However, because some of the partial current densities are below their limiting values, the analysis is strictly valid only at the center of the disk.

39981 (UCRL-Trans—11228) **Electrochemical behavior of lithium on a mercury electrode.** Gladyshev, V.P.; Ruban, L.M.; Kuleshov, V.A. Translated from *Tr. Inst. Khim. Nauk, Akad. Nauk Kaz. SSR;* **24**: 111-119(1969). 13p. P 02/MF A01.

The equilibrium potentials of lithium amalgams were determined in the range of concentrations from 0.001 to 0.1 percent by weight. It was shown that the difference in the course of the potential/amalgam concentration curve from its theoretical course was caused by the formation in the amalgam of particles which consisted of lithium ions solvated by mercury. The reduction of lithium on a mercury cathode was studied in solutions of lithium hydroxide, chloride, perchlorate and sulfate of different concentrations in the temperature range from 20 to 80° and the current density range from 0 to 100 mA/cm². The influence of the nature and concentration of the electrolyte and the influence of temperature in the 20 to 80° interval were studied in the anode oxidation of a 0.03 wt percent lithium amalgam in the current density range from 0 to 100 mA/cm². The influence of the lithium concentration in the amalgam on the limiting current of its anode oxidation was established. (auth)

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 39307, 39930, 39966

39982 Methods for OH generation in the presence of olefins: evidence for H atom abstraction from propylene by hydroxyl radicals. Henri, J.P.L.; Carr, R.W. Jr. (Univ. of Minnesota, Minneapolis). *J. Photochem.;* 69-73(1975).

Three methods of OH generation in the presence of propylene by steady-illumination photolysis methods are evaluated. The experiments provide indirect evidence that allyl radicals are formed at all experimental conditions used. Relative rate considerations suggest that OH can abstract H from the allyl position of propylene.

39983 (N—76-29380) **Reaction of NH_2 with NO_2.** Jayanty, R.K.M.; Simonaitis, R.; Heicklen, J. (Pennsylvania State Univ., University Park (USA). Ionosphere Research Lab.). Jul 1976. Contracts NGL-39-009-003;NSF GA-42856. 21p. (NASA-CR—148598; PSU-IRL-SCI—448). NTIS $3.50.

Ammonia (NH_3) was photolyzed at 213.9 nm in the presence of NO_2 at 25°C in order to study the reactions of NH_2 with NO_2. The products included NO, with a quantum yield of 1.0. The other measured products of the reaction were N_2 and N_2O with respective quantum yields of 0.94 +- 0.10 and 0.3 in the presence of small amounts of He and 0.65 +- 0.15 and 0.13 in the presence of a large excess of He. The quantum yield for NO_2 consumption was 6.0 +- 2.0 in the absence of He. These results are explained in terms of various reactions. (auth) (GRA)

39984 Evidence for predissociation of Rb_2*(C^1PI/sub u) into Rb*(^{2}P/sub 3/2) and Rb(^{2}S/sub 1/2). Feldman, D.L.; Zare, R.N. (Columbia Univ., New York). *Chem. Phys. (Amsterdam);* **15**: No. 3, 415-420(15 Jul 1976).

A nozzle beam of rubidium is irradiated by the 4765 A line of the argon ion laser, and the resulting fluorescence is spectroscopically analyzed. Under these collision-free conditions, the emission consists of molecular fluorescence from the $Rb_2C\ ^1$PI/sub u/ - X $^1\Sigma^+$/sub g/ electronic system as well as atomic fluorescence from the Rb ^{2}P/sub 3/2/ fine structure component (the Rb D_2 line) only. The latter transition is caused by partial predissociation (less than or equal to 25 percent) of the Rb_2 C ^{1}PI/sub u/ state. Within experimental error, the atomic fluorescence is not polarized and its intensity does not change when an electric field of 14.7 kV/cm is applied across the excitation region. The molecular fluorescence is polarized and has the value P = 0.345 +- 0.009. This is interpreted to be caused by the superposition of P and R as well as Q lines. Although it is not possible to identify which state causes the predissociation of the Rb_2 C ^{1}PI/sub u/ state, arguments are presented that only the Rb D_2 line would appear provided the predissociation is an adiabatic process.

39985 (N—76-28390) **Reactions of O(1d) and OH with CH_3OH, oxidation of the HCO radical, and the photochemical oxidation of formaldehyde.** Osif, T.L. (Pennsylvania State Univ., University Park (USA). Ionosphere Research Lab.). Aug 1976. Contracts NGL-39-009-003;NSF GA-12385. 142p. (NASA-CR—148511; PSU-IRL-SCI—447). NTIS $6.00.

An experimental, laboratory study of the various photochemical reactions that can occur in the mesosphere and stratosphere is presented. N_2O was photolyzed at 2139 A in the presence of CH_3OH and CO. The O(1d) produced in the photolysis reacted with CH_3OH to produce OH radicals, and thus the reactions of both O(1d) and OH were able to be studied. Also considered was the oxidation of the HCO radical. Mixtures of Cl_2, O_2, H_2CO, and sometimes N_2 or He were irradiated at 3660 A at several temperatures to photodecompose the Cl_2. The photochemical oxidation of formaldehyde was studied as follows: formaldehyde in the presence of N_2 and/or O_2 (usually dry air) was photolyzed with a medium pressure Hg lamp used in conjunction with various filters which transmit different relative amounts of Hg lines from 2894 A to 3660 A. Results are presented and discussed, along with a description of experimental procedures and apparatus, and chemical reaction kinetics. (auth)

39986 Photolysis of europium(II) perchlorate in aqueous acidic solution. Davis, D.D.; Stevenson, K.L.; King, G.K. (New Mexico State Univ., Las Cruces). *Inorg. Chem.;* **16**: No. 3, 670-673(Mar 1977).

A kinetic study of the photochemical oxidation of europium(II) ions in aqueous perchloric acid solutions over the range of acid concentrations 8.7 x 10^{-3} to 3.74 M $HClO_4$ showed the quantum yield for the reaction $Eu^{2+} + H^+$ yields $Eu^{3+} + \frac{1}{2}H_2$ to be of the form PHI = PHI_0 + k[H^+]/sup 1/2/. The quantum yield for hydrogen production increases with decreasing wavelength varying from 0.053 at 405 nm to 0.20 at 254 nm in 1 M perchloric acid solutions at 296 K. Trapping experiments with the H atom scavenger 2-propanol indicated the presence of H atoms in the bulk solution. A mechanism is proposed which involves the scavenging of geminate (Eu/sup III/H.) radical pairs by H^+ preventing secondary recombination. The acid-independent yield may arise from water acting as a scavenger.

39987 Transition metal photoassisted valence isomerization of norbornadiene. An attractive energy-storage reaction. Schwendiman, D.P.; Kutal, C. (Univ. of Georgia, Athens). *Inorg. Chem.;* **16**: No. 3, 719-721(Mar 1977).

The photoassisted valence isomerization of norbornadiene to quadricyclene in the presence of catalytic amounts of cuprous chloride in chloroform, ethanol, and in acetonitrile was described. Electron absorption spectral data indicate the preassembly of norbornadiene and copper chloride in a stoichiometric complex as a key feature of the reaction mechanism. The attractive features of the norbornadiene-quadricyclene interconversion as a solar energy storage system were discussed. (DDA)

39988 Trapping by di-tert-butyl selenoketone of the biradicals produced in the photochemistry of phenyl alkyl ketones. A kinetic study. Scaiano, J.C. (Univ. of Notre Dame, IN). *J. Am. Chem. Soc.;* **99**: No. 5, 1494-1498(2 Mar 1977).

UV irradiation of butyrophenone, valerophenone, and gamma-methylvalerophenone in the presence of di-tert-butyl selenoketone results in the consumption of the latter via biradical trapping. Quantum yields of up to 0.21 have been observed for valerophenone in benzene. In the presence of tert-butyl alcohol the quantum yields of biradical trapping are enhanced as a result of the increase in biradical lifetimes. The products of the reaction have the structure $PhCOCH_2CH_2C^1R^2RSeC(Bu/sup\ t/)_2H$ (^{1}R, ^{2}R = H, Me) and result from intramolecular hydrogen transfer in the intermediate 1,6-biradical generated in the trapping step. Di-tert-butyl selenoketone is a diffusion-controlled triplet quencher. The efficiency of trapping is higher in high viscosity solvents (e.g., tetradecane) as a result of a decrease in the rate constant for triplet quenching. The reaction of the selenoketone with 1,4-biradicals seems to be quite general and has considerably less kinetic restrictions than previously reported techniques for the study of these biradicals.

39989 Environmental effects on vibronic band intensities in pyrene monomer fluorescence and their application in studies of micel-

lar systems. Kalyanasundaram, K.; Thomas, J.K. (Univ. of Notre Dame, IN). *J. Am. Chem. Soc.;* **99**: No. 7, 2039-2044(30 Mar 1977).

The fluorescence intensities for various vibronic fine structures in the pyrene monomer fluorescence show strong solvent dependence. In the presence of polar solvents, there is a significant enhancement in the intensity of the 0—0 vibronic band at the expense of other bands. This strong perturbation in the vibronic band intensities is more dependent on the solvent dipole moment than on the bulk solvent dielectric constant. This suggests the operation of some specific solute—solvent dipole—dipole interaction mechanism. The strong perturbation of the vibronic band intensities has been used as a probe to accurately determine critical micelle concentrations and also to investigate the extent of water penetration in micellar systems.

39990 Photoionization mass spectrometry of the fluoromethylsilanes (CH3)/sub n/F/sub 4-n/Si(n=1-4). Murphy, M.K.; Beauchamp, J.L. (California Inst. of Tech., Pasadena). *J. Am. Chem. Soc.;* **99**: No. 7, 2085-2089(30 Mar 1977).

Photoionization efficiency curves for molecular ions P^+ and lowest energy fragments $(P—CH_3)^+$ for the series of methyl and fluoro substituted silanes (CH_3)/sub n/F/sub 4-n/Si (n = 1-4) are reported for photon energy ranges extending from 1 to 2 eV above the respective parent thresholds. Adiabatic ionization potentials of 9.80 +- 0.03, 10.31 +- 0.04, 11.03 +- 0.03, and 12.48 +- 0.04 eV are determined for $(CH_3)_4Si$, $(CH_3)_3SiF$, $(CH_3)_2SiF_2$, and CH_3SiF_3, respectively, with appearance thresholds of 10.03 +- 0.04, 10.70 +- 0.04, 11.70 +- 0.03, and 13.33 +- 0.04 eV for siliconium ion fragments $(CH_3)_3Si^+$, $(CH_3)_2FSi^+$, $(CH_3)F_2Si^+$, and F_3Si^+ arising from CH_3 loss. These data are interpreted in terms of the thermochemistry of the various ionic and neutral silicon species. Derived heats of formation afford accurate calculation of fluoride affinities (heterolytic bond dissociation energies, $D[R_3Si^+—F^-]$) of 219.5, 237.3, 258.4, and 302.0 kcal/mol for the siliconium ions $(CH_3)_3Si^+$, $(CH_3)_2FSi^+$, $(CH_3)F_2Si^+$, and F_3Si^+, respectively. These values are 30 to 50 kcal/mol higher than the analogous carbonium ions.

39991 The fluorescence of N,N,N',N'-tetramethyl-p-phenylenediamine (TMPD) in nonpolar organic liquids for excitation energies below and above the photoionization threshold. Wu, K.; Lipsky, S. (Department of Chemistry, University of Minnesota, Minneapolis, Minnesota 55455). *J. Chem. Phys.;* **66**: No. 12, 5614-5623(15 Jun 1977).

The fluorescence from TMPD has been studied in the solvents n-hexane, methylcyclohexane, cyclohexane, isooctane, and tetramethylsilane as a function of excitation wavelength from λ/sub ex/ =300 nm to λ/sub ex/170 nm. In no solvent is there observed any apparent decline in the fluorescence yield Phi/sub f/ for excitation energies to 0.7—0.9 eV above the photoionization threshold. At higher energies Phi/sub f/ declines slightly. However, in the presence of low concentrations of either carbon tetrachloride, chloroform, ethylbromide, or n-perfluoroheptane there is observed an abrupt increase in the quenching efficiency of the TMPD fluorescence almost precisely at an excitation energy equal to the threshold energy for photoionization ϵ/sub t/. The quenchable species S/sub e/ generated at ϵ/sub t/ is found to have the following properties: (a) the probability of its quenching follows the usual Stern—Volmer form characteristic of the quenching of a spatially coherent excited state and not of a geminate ion pair; (b) the quantum yield eta/sub e/ for the production of S/sub e/ in isooctane exhibits two maxima at ϵ/sub ex/=5.6₄eV (eta/sub e/=0.41) and ϵ/sub ex/=7.1 eV (eta/sub e/=0.66) and appears generally to be relatively insensitive to the nature of the solvent; (c) the quenching constant of S/sub e/ exhibits a strong variability with the nature of the quencher and of the solvent which is qualitatively similar to the variability of the reaction rate constant of a "quasifree" electron with these quenchers in these solvents; (d) the quenching constant of S/sub e/ continuously changes as ϵ/sub ex/ increases above ϵ/sub t/ but the quenching probability continues to retain the Stern—Volmer form.

RADIATION CHEMISTRY

REFER ALSO TO CITATION(S) 39982

39992 Nuclear magnetic resonance in pulse radiolysis. II. CIDNP in radiolysis of aqueous solutions. Trifunac, A.D.; Nelson, D.J. (Argonne National Lab., IL). *J. Am. Chem. Soc.;* **99**: No. 6, 1745-1752(16 Mar 1977).

Applications of magnetic resonance to the study of radiolysis are illustrated. The products of radiolytically produced radicals exhibit CIDNP when examined, seconds after their creation, by NMR. Irradiation with a pulsed electron beam (3 MeV) was carried out in variable magnetic fields and the irradiated solutions were transferred to the NMR sample tube using a fast flow system. Aqueous solutions of methanol, iodomethane, ethylene glycol, acetate, and chloroacetate were studied. In these systems CIDNP in numerous products and starting materials can be observed. The "primary radicals" of radiolysis e/sub aq/$^-$ and H play a significant role in the polarization pathways. Applicability of the radical pair model of CIDNP to radiation chemistry is illustrated.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

REFER ALSO TO CITATION(S) 40586

HOT-ATOM CHEMISTRY

39993 Correlation between the average energy of reaction and system composition in recoil hot reaction studies. Stevens, D.J.; Spicer, L.D. (Department of Chemistry, University of Utah, Salt Lake City, Utah 84112). *J. Chem. Phys.;* **66**: No. 11, 5253-5255(1 Jun 1977).

An expression is derived for the average energy of reaction as a function of system composition in recoil hot atom reactions.(AIP)

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 39293, 39345, 39353

39994 Synthesis, crystal structure, and reactions of an actinide metallocarborane complex, bis(eta^5-(3)-1,2-dicarbollyl)dichlorouranium(IV) dianion, $[U(C_2B_9H_{11})_2Cl_2]^{2-}$. Fronczek, F.R.; Halstead, G.W.; Raymond, K.N. (Univ. of California, Berkeley). *J. Am. Chem. Soc.;* **99**: No. 6, 1769-1774(16 Mar 1977).

The reaction of UCl_4 with the $C_2B_9H_{11}^{2-}$ anion in tetrahydrofuran solution under inert atmosphere conditions has led to the formation of the complex anion $[U(C_2B_9H_{11})_2CL_4]^{2-}$, which has been isolated as several air-sensitive crystalline salts. The salt $[Li(OC_4H_8)_4]_2[U(C_2B_9H_{11})_2Cl_2]$ has been subjected to an x-ray crystal structure determination using counter intensity data. The complex anion is found to exhibit approximate C/sub 2v/ symmetry, with the ligands arranged in a distorted tetrahedral array about uranium. The average U-B distance to the pentahapto-bonded dicarbollide ligands is 2.73 (2) A, and the average U—Cl distance is 2.599 (6) A. The Cl—U—Cl angle is 90.3 (5)°, and the dicarbollide bonding face centroids form an angle of 137° about the uranium atom. Refinement in space group Cc fitting 2020 data by 322 parameters led to agreement indices R = 0.058 and R/sub w/ = 0.061. Unit cell dimensions are a = 26.410 (7) A, b = 11.248 (5) A, c = 20.163 (6) A, β = 102.35 molecules, with an average Li—O distance of 1.92 (3) A. The $[U(C_2B_9H_{11})_2Cl_2]^{2-}$ anion reacts with C_8H_8 to yield uranocene, pentadienide. In actinide complexes, the dicarbollide dianion seems to have ligating properties which are intermediate between those of the cyclooctatetraene dianion and cyclopentadienide.

39995 Thermochemistry of gaseous UF_5 and UF_4. Hildenbrand, D.L. (Stanford Research Institute, Menlo Park, California 94040). *J. Chem. Phys.;* **66**: No. 11, 4788-4794(1 Jun 1977).

Thermochemical data for gaseous UF_5 and UF_4 were obtained from equilibrium and electron impact measurements made by high temperature mass spectrometry. Equilibrium measurements yielded for the gaseous reaction $Ag+UF_5=AgF+UF_4$ the enthalpy change $\Delta H_{298}=16.9$ +- 1.5 kcal by second law analysis. Additionally, the sublimation of UF_4(s) was studied by the torsion—effusion method, leading to ΔH_{298}(sub) =76.2 +- 0.5 kcal/mol. These results were combined with auxiliary thermochemical data to derive the standard heats of formation $\Delta Hf\ degree_{298}(UF_5, g)$ =-460.6 +- 3.4 kcal/mol and $\Delta Hf\ degree_{298}(UF_4, g)$ = -377.8 +- 0.6 kcal/mol, and the bond dissociation energies $D_0(F_5U—F)$ =68.3 +- 3.5 kcal and $D_0(F_4U—F)$ =101.0 +- 3.4 kcal. Threshold energies for formation of UF_5^+ and UF_4^+ by dissociative ionization of UF_6 were determined along with the ionization potentials of UF_6(14.00 eV), UF_5 (11.29 eV), and UF_4 (9.96 eV), leading to the BDE values $D_0(F_5U—F)$ =68.0 +- 3.2 kcal and $D_0(F_4U—F)$ =102.4 +- 3.2 kcal, in agreement with the equilibrium data. Uncertainties associated with the measurements and the interpretation of the data are discussed. The entropy of UF_5(g) inferred from the equilibrium measurements was used in a third law treatment of published UF_5 sublimation data, giving thermochemical results in good agreement with the above. The UF_4 sublimation measurements lead to a vapor entropy that seems more compatible with a molecular configuration of lower symmetry than the obvious tetrahedral structure.

RADIOISOTOPE PRODUCTION

39996 (ORNL—5216) **Transuranium processing plant semiannual report of production, status, and plans for period ending June 30, 1976.** King, L.J.; Bigelow, J.E.; Collins, E.D. (Oak Ridge National Lab., Tenn. (USA)). Feb 1977. Contract W-7405-ENG-36. 32p. P 03/MF A01.

During the period January 1, 1976, through June 30, 1976, the following amounts of transuranium elements were recovered from ten irradiated HFIR targets: 2 g ^{243}Am, 50 g ^{244}Cm, 29 mg ^{249}Bk, 277 mg ^{252}Cf, 1.7 mg ^{253}Es, and 0.5 pg ^{257}Fm. About 50 mg of high-purity ^{248}Cm was purified chemically for shipment, and another 75 mg of ^{248}Cm was separated from ^{252}Cf. Nineteen HFIR targets, each containing approximately 9 g of curium, were fabricated. There have been no changes during this report period in the chemical processing flowsheets normally used at TRU. Five neutron sources were fabricated, bringing the total fabricated to 84. Six sources that were used previously in various projects have been returned to TRU and are available for reassignment. Special projects included (1) the continued study of ^{250}Cm production by irradiation of ^{248}Cm; (2) the production of 0.54 mg of ^{250}Cf by irradiation of ^{249}Bk; (3) the separation of approximately 200 pg of ^{254}Cf from 39-hr /sup 254m/Es that was produced by irradiation of 5 μg of ^{253}Es; and (4) the determination of process steps needed to obtain rare-earth fission products in an oxide form from LiCl-based anion exchange raffinate solution.

39997 **Production of high purity radiothallium.** Lebowitz, E.; Greene, M.W. (to Energy Research and Development Administration). US Patent 3,993,538. 23 Nov 1976. Filed date 27 Jan 1976. 6p. PAT-APPL-646,781.

The method of producing high-purity thallium-201 for use as a myocardial scanning agent comprises the steps of irradiating a thallium target with protons to give the reaction ^{203}Tl(p,3n)^{201}Pb, separating in ion exchange columns the lead from the thallium isotopes, permitting the lead to decay, and then purifying the thallium solution and converting the thallium present to thallous form in which it can be used.

COMBUSTION CHEMISTRY

39998 (COO—4062-3) **Modeling two-phase flow in a swirl combustor. Technical progress report, December 4—February 1, 1977.** Lewellen, W.S.; Segur, H.; Varma, A.K. (Aeronautical Research Associates of Princeton, Inc., N.J. (USA)). Feb 1977. Contract EY-76-C-02-4062. 9p. P 02/MF A01.

During the past two months work has been concentrated on two tasks in the program to model two-phase flow in a swirl combustor. First, a computer program has been written and debugged to implement the phenomenological model outlined in the December 1976 progress report. Second, a more detailed analysis of the cylindrical wall layer has been initiated to reduce the empiricism required to model this critical region. Carrying out verification tests on the model using experimental test results from Pittsburg Energy Research Center during the next few months is anticipated.

39999 (BNWL-tr—233) **Experimental and theoretical study of the ignition of the alkaline metals lithium, sodium, and potassium.** Malet, J.C.; Mellottee, H.; Delbourgo, R. Translated by C. Sample from *J. Chim. Phys.;* **69**: No. 9, 1315-1321(1972). 15p. P 02/MF A01.

The ignition of pool burning liquid lithium, sodium and potassium has been investigated in a statical apparatus. The experimental values of the spontaneous ignition temperatures found for lithium and sodium are consistent with the theoretical values deduced from Reynolds equations and more specifically, for sodium, from Glassman's model. In the case of potassium the ignition temperature found is higher than any value reported in the literature. This discrepancy is ascribed to heat losses by conduction which appear to be significant in the experimental device used.

ENGINEERING

GENERAL ENGINEERING

40000 **Velocity of bodies powered by rapidly discharged cold-gas thrusters.** Bennett, M.D. (Sandia Labs., Albuquerque, NM). *J. Spacecr. Rockets;* **12**: No. 4, 254-256(Apr 1975).

The ideal velocity imparted to a missile as a result of discharging the chemically nonreacting fluid from a thermally insulated tank is studied. An equation is derived which expresses the approximate velocity of isentropically discharged thrusters.

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 39726

40001 (ANL-CT—77-9) **Nonlinear formulation of finite element by corotational coordinates.** Hsieh, B.J. (Argonne National Lab., Ill. (USA)). Jan 1977. Contract W-31-109-ENG-38. 28p. P 03/MF A01.

Certain aspects of the finite element formulation in corotational coordinates are discussed. This is a coordinate system that rotates and translates with the element to which it is allocated. It is shown that the displacement field of each element can be separated into rigid-body-motion displacements and deformation displacements by using Gauss's polar decomposition theorem. The strains, stresses, and internal forces are computed in the corotational coordinates. This approach greatly simplifies the computations of strains and stresses when the displacements and strains are not small.

40002 (COO—3077-134) **Transonic flow theory of airfoils and wings.** Garabedian, P.R. (New York Univ., N.Y. (USA). Courant Inst. of Mathematical Sciences). 1976. Contract EY-76-C-02-3077;NASA-NGR-33-016-167;NASA-33-016-201. 8p. (CONF-761110—4; NASA-CP—2001). Dep. NTIS $3.50.

From 13. annual meeting of the Society of Engineering Science, Inc.; Hampton, Virginia, United States of America (USA) (1 Nov 1976).

Supercritical wing technology is expected to have a significant influence on the next generation of commercial aircraft. Computational fluid dynamics is playing a central role in the development of new supercritical wing sections. One of the principal tools is a fast and reliable code that simulates two-dimensional wind tunnel data for transonic flow at high Reynolds numbers. This is used widely by industry to assess drag creep and drag rise. Codes for the design of shockless airfoils by the hodograph method have not been so well received because they usually require a lot of trial and error. However, a more advanced mathematical approach makes it possible to assign the pressure as a function of the arc length and then obtain a shockless airfoil that nearly achieves the given distribution of pressure. This tool should enable engineers to design families of transonic airfoils more easily both for airplane wings and for compressor blades in cascade.

40003 (SAND—76-0280) **PFLASH: a program to calculate Fourier cosine coefficients for pressure distributions.** Leisher, W.B. (Sandia Labs., Albuquerque, N.Mex. (USA)). Aug 1976. Contract EY-76-C-04-0789. 31p. P 05/MF A01.

PFLASH is designed to convert measured surface pressure histories of test units to Fourier cosine series coefficient histories for use with structural response codes. The use conditions, algorithm, constraints, and accuracies are described.

40004 (Y—2066) **Ultraprecise parabolic interpolator for numerically controlled machine tools.** Davenport, C.M. (Oak Ridge Y-12 Plant, Tenn. (USA)). Feb 1977. Contract W-7405-ENG-26. 86p. P 05/MF A01.

The mathematical basis for an ultraprecise digital differential analyzer circuit for use as a parabolic interpolator on numerically controlled machines has been established, and scaling and other error-reduction techniques have been developed. An exact computer model is included, along with typical results showing tracking to within an accuracy of one part per million.

40005 (BNWL-tr—234) **Uniform design calculations for heat exchangers.** Bosnjakovic, F.; Vilicic, M.; Slipcevic, B. Translated from *VDI (Ver. Dtsch. Ing.) Forschungsh.;* No. 432, 5-26(1950). 75p. P 04/MF A01.

A method for making design and performance computations for apparatus for stationary heat exchange is presented. The method is general in character and is suitable for simple apparatuses operating on the principle of parallel flow, counter flow, and various types of cross flow. It is also applicable for coupled heat exchangers consisting of similar or different parts.

40006 (BNWL-tr—243) **Substantial increase in welding speed in the electroslag process with simultaneous improvement of joint quality.** Eichhorn, F.; Hirsch, P. Translated from *DVS Ber.;* No. 31, 37-44(1974). 29p. P 03/MF A01.

Preliminary test results on improving structural properties in the heat-affected zone (HAZ) by substantially increasing welding speed are reported. In the case of good toughness properties in the center of the weld, this is permitted by using higher welding currents and currentless addition of welding filler in the form of metal powder. The objective of further research efforts is the development of adequate toughness properties of electroslag-welded joints without normalizing postheat treatment. The investigations on electroslag-welded joints suggest that toughness properties can be improved by introducing currentless filler in the form of metal powder and by using higher amperages and welding speeds. In the weld metal, this can be attributed to the reduced overheating of the metal pool and the ability of currentless filler containing crystallization nuclei to produce fine grains. In the critical HAZ near the seam, the lowered strain energy causes an increase in temperature gradients and shorter dwell times in the range of higher temperatures. As a result, the structural patterns are favorably influenced.

40007 Influence of crack closure and elasto-plastic flow on the bending of a cracked plate. Jones, D.P. (Westinghouse Electric Corp., West Mifflin, PA); Swedlow, J.L. *Int. J. Fract.;* **11**: No. 6, 897-914(Dec 1975).

The influence of crack closure and elasto-plastic flow on the bending behavior of thin cracked plates was investigated through use of an incremental elasto-plastic plate bending finite element computer program. The finite element program was developed using assumptions consistent with Kirchhoff fourth order plate theory while the material property treatment permits general isotropic work hardening with local elastic unloading. This technique was applied to the problem of a large centrally through cracked plate subject to remote circular bending. Comparison is drawn between two cases of the bending problem. The first neglects the possibility of crack face interference with bending, and the second includes a kinematic prohibition against the crack face from passing through the symmetry plane. Results are reported which isolate the effects of elasto-plastic flow and crack closure.

40008 Compact gate valve. Bobo, G.E. (to Energy Research and Development Administration). US Patent Application 686,446. 13 May 1976. 6p.

A double-disc gate valve which is compact, comparatively simple to construct, and capable of maintaining high closing pressures on the valve discs with low frictional forces is described. The valve casing includes axially aligned ports. Mounted in the casing is a sealed chamber which is pivotable transversely of the axis of the ports. The chamber contains the levers for moving the valve discs axially, and an actuator for the levers. When an external drive means pivots the chamber to a position where the discs are between the ports and axially aligned therewith, the actuator for the levers is energized to move the discs into sealing engagement with the ports.

40009 Rib forming tool for tubing. Rowley, J.P.; Lewandowski, E.F.; Groh, E.F. (to Energy Research and Development Administration). US Patent 3,991,599. 16 Nov 1976. Filed date 2 Dec 1975. 6p.

PAT-APPL-636,883.

Three cylindrical rollers are rotably mounted equidistant from the center of a hollow tool head on radii spaced 120° apart. Each roller has a thin flange; the three flanges lie in a single plane to form an internal circumferential rib in a rotating tubular workpiece. The tool head has two complementary parts with two rollers in one part of the head and one roller in the other part; the two parts are joined by a hinge. A second hinge, located so the rollers are between the two hinges, connects one of the parts to a tool bar mounted in a lathe tool holder. The axes of rotation of both hinges and all three rollers are parallel. A hole exposing equal portions of the three roller flanges is located in the center of the tool head. The two hinges permit the tool head to be opened and rotated slightly downward, taking the roller flanges out of the path of the workpiece which is supported on both ends and rotated by the lathe. The parts of the tool head are then closed on the workpiece so that the flanges are applied to the workpiece and form the rib. The tool is then relocated for forming of the next rib.

40010 Electrode assembly for a fluidized bed apparatus. Schora, F.C. Jr.; Matthews, C.W.; Knowlton, T.M. (to Energy Research and Development Administration). US Patent 3,993,450. 23 Nov 1976. Filed date 19 Feb 1975. 8p.

PAT-APPL-551,225.

An electrode assembly is described which consists of: a high voltage electrode having a generally cylindrical shape and being electrically connected to a high voltage source, where the cylinder walls may be open to flow of fluids and solids; an electrically grounded support electrode supporting said high voltage electrode by an electrically insulating support where both of the electrically grounded and electrically insulating support may be hollow; and an electrically grounded liner electrode arranged concentrically around both the high voltage and support electrodes. This assembly is specifically adapted for use in a fluidized bed chemical reactor as an improved heating means therefor.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 40082, 40096, 40677

40011 (PB—258568) **Josephson junction based voltage standard. Final report.** Field, B.F.; Hesterman, V.W. (National Bureau of Standards, Washington, D.C. (USA). Electricity Div.; Superconducting Technology, Inc., Mountain View, Calif. (USA)). 1975. 7p. Q 02/MF A01.

Sponsored in part by Aerospace Guidance and Metrology Center, Newark Air Force Station, Ohio. Prepared in cooperation with Superconducting Technology, Inc., Mountain View, Calif. Pub. in Cal Poly Measurement Science Conference (5th), San Luis Obispo, Calif., 5—6 Dec 1975 (California Polytechnic State Univ.) 1975.

An instrument is described that is designed to calibrate cadmium-sulfate (Weston) standard cells to an accuracy (3 sigma) of 1 ppM or better. This instrument can replace the involved procedures, equipment and calibrations presently used to maintain a unit of voltage in many standards laboratories. A Josephson tunnel junction operating at cryogenic temperatures is used as a time-invariant reference for a special potentiometer which directly measures the emf of a standard cell. The instrument is easy-to-use and requires an infrequent frequency calibration.

40012 (BNL-tr—629) **Superconducting transformers, rectifiers, and switches. (Review paper).** Ignatov, V.E.; Koval'kov, G.A.; Moskvitin, A.I. (Krzhizhanovskij Ehnergeticheskij Inst., Moscow (USSR)). 1974. Translation by S.J. Amoretty of USSR report. 66p. Dep. NTIS $4.50.

Cryogenic rectifiers using power cryotrons have been fabricated by many foreign firms since 1960. Present-day flux pumps require a low voltage power supply (several tens of millivolts) and a high current (kiloamperes). Increasing the power supply voltage will quadratically increase the flux pump losses and, given the limitations of existing materials, are not economically profitable. Present-day, cryotron-type flux pumps can best be used in power systems as a power supply for superconducting magnets, solenoids, storage devices, and superconducting exciting coils for turbogenerators. To increase the voltage of the next generation of transformers for superconducting dc power transmission, a research program must be set up to improve the cryotrons and to develop systems based on a different principle of operation, for example, semiconductor devices based on the principle of the volume effect in the intermediate environment.

PROTECTIVE STRUCTURES AND EQUIPMENT

REFER ALSO TO CITATION(S) 40493

40013 (LA—6722-PR) **Respirator studies for the National Institute for Occupational Safety and Health. Progress report, July 1, 1975—December 31, 1976.** Lowry, P.L.; Hack, A.L.; Yasuda, S.K.; Wheat, L.D.; Bustos, J.M.; Douglas, D.D. (Los Alamos Scientific Lab., N.Mex. (USA)). Feb 1977. Contract W-7405-ENG-36. 31p. P 03/MF A01.

Respirator studies carried out during the period July 1, 1975 through December 31, 1976 for the National Institute for Occupational Safety and Health were directed at the development of respirator test equipment and methods to improve the means for evaluating the performance of respirators. Major efforts included development of a respirator man-test system using a gaseous test agent; determining the feasibility of constructing equivalent high-efficiency particulate filters to replace sorbent cartridges for man-tests using particulate test agents; fit-testing powered air-purifying respirators; completion of a study comparing NaCl aerosol-filter test with silica-dust and silica-mist filter test; and surveying of possible methods for evaluating the facial fit of single-use gas and vapor respirators.

SHIPPING CONTAINERS

40014 (SAND—76-0603) **Subcriticality guidelines for LMFBR spent-fuel shipping casks.** Philbin, J.S.; Dupree, S.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1977. Contract EY-76-C-04-0789. 47p. Dep. NTIS $4.00.

Three-dimensional Monte Carlo criticality calculations have been performed with KENO IV on two types of LMFBR subassemblies placed in configurations considered appropriate for shipping-cask applications. The report presents the effects of geometry, coolant, and loading changes--along with shield/structure material selection—on the self-multiplication of such systems. An example is shown which permits the determination of the maximum payload of CRBR fuel allowed under specified limits for k/sub eff/. Fuel enrichment, number of subassemblies, and type of coolant used are generally the most sensitive variables affecting self-multiplication. Of lesser importance are the type of gamma shield used and the pitch between subassemblies; the choice of neutron-shield material and outer case structure are of least importance. The correlations presented are expected to be useful in making decisions related to shipping-cask designs.

40015 (JPNRSR—33) **Experimental study on the fire resistance of used nuclear fuel shipping containers. Research report.** (Science and Technology Agency, Tokyo (Japan)). 16 Jan 1976. Translation of Japanese report 51-585. 97p. U 05/MF A01.

Work performed under United States Nuclear Regulatory Commission—Light Water Reactor Safety Technical Exchange Program.

Scale models of spent fuel shipping casks were tested for fire resistance under various temperature and time conditions. Test methods and results are presented. (TFD)

TRANSPORT AND STORAGE FACILITIES

40016 Anatomy of a hydraulic transient. Techo, R. (Georgia State Univ., Atlanta). pp 242-246 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

This presentation consists of a five minute showing of a series of slides depicting the computer simulation of a hydraulic transient generated in a multiple station liquid pipeline system. Progress of the transient is followed from slide to slide with each slide representing the state of the system after a three second interval. Conditions are shown where pumping station safety devices automatically shut-down pump units whenever certain pressure limits are exceeded. These slides provide a clearer insight into the nature and interactions of the time-varying complex phenomena represented by hydraulic surges.

MINING AND DRILLING EQUIPMENT AND FACILITIES

REFER ALSO TO CITATION(S) 39205, 39209, 39219, 39221

40017 Casing stresses caused by buckling of concentric pipes. Christman, S.A. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 16p. (CONF-761008—115).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

A technique is developed to analyze the buckling stability of multiple, concentric pipes. If the system is unstable and buckles against a lateral support such as an irregular open hole, an estimate is made of the elastic stresses and pipe curvature. Example applications are presented in offshore platform wells, in floating drilling, and for partially cemented surface casings.

LASERS

REFER ALSO TO CITATION(S) 40109

40018 (SAND—76-0671) **Alignment technique for locating the reflected signal of an infrared laser off a remote target.** McCarthy, A.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1977. Contract EY-76-C-04-0789. 7p. P 02/MF A01.

A technique for locating the signal reflected from a mirror located some distance from a pulsed infrared (IR) laser is described. The technique utilizes a visible He-Ne laser which is mechanically and optically positioned so that its output beam is colinear with the IR laser beam.

40019 (N—76-27727) **Laser sources for gas analysis equipment in 2-20 micron range. Part 2. Parametric oscillator for 2-10 micron. Final report.** Matthes, H.; Marschall, N.; Korczak, P. (Allgemeine Elektricitaets-Gesellschaft AEG Telefunken, Frankfurt am Main (Germany, F.R.)). Dec 1975. 77p. (BMFT-FB-T—75-47). NTIS $5.00.

Sponsored by Bundesmin. Fuer Forsch. U. Technol.

A tunable solid state laser in the form of a parametric oscillator can be used for the detection of air pollution gases. The ternary sulfide $AgGaS_2$ is of special interest for the use as nonlinear-optical material. However, this material was not available in single crystalline form of the required quality. Therefore, the growth process was investigated to obtain such high quality crystals. Sufficiently large (5 x 5 x 5 cu mm), crackfree and twinfree crystals could be obtained by the Bridgman method after optimizing the composition of the melt and the geometry of the quartz ampoules. A decisive improvement of the transmission properties could be obtained by a subsequent annealing process. (GRA)

40020 Electro-optics/laser international '76 UK. Conference proceedings. Jerrard, H.G. (ed.). Guildford, Eng.; IPC Science and Technology Press, Ltd. (1976). 248p. (CONF-760378—). pounds 18.00.

From Electro-optics/laser international '76 conference; Brighton, United Kingdom of Great Britain and Northern Ireland (UK) (9 Mar 1976).

A separate abstract was prepared for nine of the forty-nine papers presented at the conference. (TFD)

40021 Channelled substrate buried heterostructure (GaAl)As injection lasers. Kirkby, P.A.; Lovelace, D.F.; Thompson, G.H.B. (Standard Telecommunications Labs. Ltd., Harlow, Eng.). pp 1-3 of In Electro-optics/laser international '76 UK. Conference proceedings. Jerrard, H.G. (ed.). Guildford, Eng.; IPC Science and Technology Press, Ltd. (1976).

From Electro-optics/laser international '76 conference; Brighton, United Kingdom of Great Britain and Northern Ireland (UK) (9 Mar 1976).

See CONF-760378—.

A technique for fabricating stripe geometry GaAs/(GaAl)As injection lasers with optical and carrier confinement not only in the plane perpendicular but also parallel to the p-n junction is reported. The independently developed channelled substrate technique is a simple extension of conventional liquid phase epitaxy requiring no regrowth and relies on the strong tendency of epitaxial layers to smooth out as they grow. The active regions of the preliminary 10 and 20 μm wide stripe lasers that have been fabricated to date are parabolic in cross section, tapering gradually to zero at the edges and completely embedded in GaAlAs. Unlike the "etched buried heterostructure lasers" recently reported by Burnham and Scifres, the n-(GaAl)As layer is continuous thus preventing the direct injection of carriers into the substrate. Room temperature pulsed threshold currents are in the range 150-350 mA with efficiencies up to 30 percent. A model has been developed from which the transverse mode structure in the plane of the junction can be calculated. This model predicts Hermite-Gaussian distributions in both the near and far fields. Extremely good agreement is obtained between calculated and experimental far-field patterns. It is believed that the channelled substrate technique can be developed to produce an injection laser that is almost ideal for optical communication systems and integrated optics and is simple to fabricate.

40022 Fabrication and performance characteristics of c-w stripe geometry GaAs/(GaAl)As lasers for optical communications. Goodwin, A.R.; Bourne, W.O.; Pion, M.; Selway, P.R. (Standard Telecommunications Labs. Ltd., Harlow, Eng.). pp 4-7 of In Electro-optics/laser international '76 UK. Conference proceedings. Jerrard, H.G. (ed.). Guildford, Eng.; IPC Science and Technology Press, Ltd. (1976).

From Electro-optics/laser international '76 conference; Brighton, United Kingdom of Great Britain and Northern Ireland (UK) (9 Mar 1976).

See CONF-760378—.

Oxide insulated stripe geometry double heterostructure GaAs/(GaAl)As lasers have been made and evaluated as sources for optical communications systems. The paper describes the fabrication of the devices, including the liquid phase epitaxy and device processing stages. Attention is given to some details which are important in controlling the device performance parameters. Evaluation of the lasers has included studies of reliability, performance at elevated temperatures, spatial mode structure and spectral properties. In addition the modulation performance has been studied. Results of these measurements will be presented which show that operation is possible with pulse rates in the 100-500 MHz region at temperatures above 50°C and with lives well in excess of 10,000 h. Predominantly single transverse mode operation can be achieved and frequently devices operate in a few longitudinal modes giving rise to spectral bandwidths of less than 10 A.

40023 Optical noise in GaAs light emitting diodes. Bolleter, W.; Conti, J.; Guekos, G.; Tenchio, G. (Swiss Federal Inst. of Tech., Zurich). pp 8-11 of In Electro-optics/laser international '76 UK. Conference proceedings. Jerrard, H.G. (ed.). Guildford, Eng.; IPC Science and Technology Press, Ltd. (1976).

From Electro-optics/laser international '76 conference; Brighton, United Kingdom of Great Britain and Northern Ireland (UK) (9 Mar 1976).

See CONF-760378—.

The cross-correlation between the random fluctuations of the light intensity and the current of GaAs LED's has been measured in the l.f. frequency range at room temperature. A strong dependence of the cross-correlation on the direction of radiation is found. From a simple LED equivalent circuit a relation linking the excess noise factor and the coherence function is calculated which fits qualitatively well with the measured results. By an optoelectronic feedback method the excess noise of the light intensity in the low frequency domain can be eliminated. Finally the dependence of the excess noise in the radiation from cwDH GaAlAs diode lasers on current and frequency is shown in the l.f. frequency range.

40024 Performance and stability criteria of a c-w acousto-optically mode-locked Nd:YAG laser system. Waddington, J.H. (Xerox Research, Welwyn, Eng.). pp 12-25 of In Electro-optics/laser international '76 UK. Conference proceedings. Jerrard, H.G. (ed.). Guildford, Eng.; IPC Science and Technology Press, Ltd. (1976).

From Electro-optics/laser international '76 conference; Brighton, United Kingdom of Great Britain and Northern Ireland (UK) (9 Mar 1976).

See CONF-760378—.

Mode-locking of the cw Nd: YAG laser has been achieved using a simple Bragg type acousto-optic modulator. The theoretical and practical design parameters of the modulator have been determined and high scattering efficiencies in the region of 80% have been achieved in a flint glass (SF6) device operating at 87 MHz with

only 1.5 W of rf power supplied to the transducers. Stable mode-locking of this system has been obtained with pulse widths of 240 ps. Measurements into the parameters governing this width and stability have been carried out and the results are in excellent agreement with the theoretical predictions of Kuizenga and Siegman and Haken and Pauthier. Detuning of the laser has also been investigated and two different types of highly stable relaxation processes were observed at the theoretically predicted resonant peak. When operated in the stable detuned mode second-harmonic enhancements of 330 have been measured over the free-running condition. Finally, self-locking of the cw laser has been observed when the resonator mirrors are judiciously adjusted and the output power confined to the fundamental transverse mode.

40025 High stability TEA CO_2 laser system. Maggs, P.N.D. (Univ. of Essex, Colchester, Eng.). pp 26-30 of In Electro-optics/laser international '76 UK. Conference proceedings. Jerrard, H.G. (ed.). Guildford, Eng.; IPC Science and Technology Press, Ltd. (1976).

From Electro-optics/laser international '76 conference; Brighton, United Kingdom of Great Britain and Northern Ireland (UK) (9 Mar 1976).

See CONF-760378—.

The many different TEA CO_2 laser designs that have been published usually suffer from defects affecting amplitude and frequency stability. These problems are examined, and the effectiveness of various solutions discussed. A system designed to minimize these limitations is described. The system will generate pulse powers of several hundred kW in a single axial mode, with an amplitude stability of +-4 percent at pulse repetition frequencies up to 100 pps over the 10.4μm band. A novel power limiter based on InSb is described that will further increase pulse to pulse reproducibility considerably. Existing limitations are discussed together with future improvements.

40026 Radiating characteristics of a single-channel injection laser. Mironov, Yu.M.; Molochev, V.I.; Nikitin, V.V.; Semenov, A.S. (Lebedev Inst. of Physics, Moscow). pp 31-33 of In Electro-optics/laser international '76 UK. Conference proceedings. Jerrard, H.G. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1976).

From Electro-optics/laser international '76 conference; Brighton, United Kingdom of Great Britain and Northern Ireland (UK) (9 Mar 1976).

See CONF-760378—.

The method of manufacture of single channel lasers is described and their characteristics discussed. They can operate in the single frequency mode high above threshold and compare favourably with gas lasers as sources of coherent radiation.

40027 Large aperture, low voltage PLZT ceramic modulator for laser Q-switching at 1064 nm. Kirkby, C.J.; Waterworth, P. (Plessey Co. Ltd., Towcester, Eng.). pp 84-88 of In Electro-optics/laser international '76 UK. Conference proceedings. Jerrard, H.G. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1976).

From Electro-optics/laser international '76 conference; Brighton, United Kingdom of Great Britain and Northern Ireland (UK) (9 Mar 1976).

See CONF-760378—.

Symmetry prevents the appearance of a true longitudinal electro-optic effect in ferroelectric ceramic materials. A new configuration, comprising a PLZT ceramic slice bearing transparent electrodes and oriented between crossed polarisers at an angle to the incident light axis, allows application of polycrystalline materials in large aperture modulators without the need for interdigital electrode structures for aperture synthesis. Half-wave retardation at 633 nm is obtained at 400 volts in a device 0.2 mm in thickness, with uniform extinction ratio of 30 : 1 and rise times faster than 100 nS. The applicability to laser Q-switching at 1064 nm and the problems involved are discussed.

40028 Use of ADP as a TIR intercavity laser switch. Gavrilidis, C.; Palmer, A.W.; Widdis, F.C. (City Univ., London). pp 89-91 of In Electro-optics/laser international '76 UK. Conference proceedings. Jerrard, H.G. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1976).

From Electro-optics/laser international '76 conference; Brighton, United Kingdom of Great Britain and Northern Ireland (UK) (9 Mar 1976).

See CONF-760378—.

The application of the crystal ADP for the development of an electro-optic diffraction-type modulator is considered. This modular/deflector has been developed as a low voltage, low capacity device for Q-switching and mode-locking applications. In the arrangement considered the light is reflected from the crystal base onto which are deposited inter-digital electrodes. The cross sectional shape of the crystal is triangular and the light is transmitted into and out of the surrounding media through the other two sides which are equal in length. The light is thus not deflected when the voltage applied to the electrodes is zero. The advantages of this arrangement are that the capacitance associated with the interdigital electrodes is low compared with the capacitance of a conventional arrangement in which parallel type electrodes are utilized and that as the light is polarized in the direction of one of the axes only, birefringent effects do not affect the operation of the modulator.

40029 (N—76-28544) Exposure damage mechanisms for KCl windows in high power laser systems. Final report, Nov 1974—Mar 1976. Blaszuk, P.R.; Woody, B.A.; Hulse, C.O.; Davis, J.W.; Waters, J.P. (United Technologies Research Center, East Hartford, Conn. (USA)). Mar 1976. 144p. (NASA-CR—134982; R—76-912038-12). NTIS $6.00.

An experimental study of the 10.6 micrometer and 0.6328 micrometer optical properties of single crystal and europium doped polycrystal is described. Significant variations in the optical properties are observed over periods of exposure up to 100 hours. Models are proposed to predict the 10.6 micrometer absorptivity for long exposure periods. Mechanical creep has been detected in both materials at high temperature. (GRA)

40030 (AD-A—028804) Development of tunable infrared parametric oscillators and coherent tunable source spectroscopy. Final report. Byer, R.L.; Henesian, M.; Komine, H.; Levatter, J. (Stanford Univ., Calif. (USA). Edward L. Ginzton Lab.). May 1976. Contract N00014-75-C-0894. 18p. (GL—2578). NTIS $3.50.

Also includes rept. No. GL—2522, Optically Pumped Superfluorescent Na2 Molecular Laser, pub. in Jnl. of Applied Physics, v47, n4, p1515-1518, Apr 1976.

Studies are described of Na' by optical pumping, and laser action on both the A and B molecular bands was demonstrated. Work was initiated on optically pumping Hg_2, initial discharge studies of Na_2 were carried out, and a discharge pumped XeF laser was demonstrated.

40031 (N—76-28980) Inelastic scattering of 61-MeV protons by Pb-207. Final report, 1 Sep 1975—31 Jul 1976. Owais, M. (Paine Coll., Augusta, Ga. (USA)). Jul 1976. 48p. (NASA-CR—148531; PC-NAS—004). NTIS $4.00.

Differential cross sections for the excitation of the first four neutron-hole states and the doublet at 2.61 MeV by 61.2 MeV protons were measured. The data are analyzed in terms of both a purely collective model description and a microscopic model supplemented by macroscopic core polarization. A realistic two-body interaction is used and knock-on amplitudes are included. Core polarization is found to be important but represents a relatively smaller contribution than in most nuclei previously studied. A parallel analysis of similar data at lower proton bombarding energies reveals a surprisingly strong energy dependence of the reaction mechanisms. (auth)

40032 Atmospheric-pressure copper laser. Isakov, I.M.; Leonov, A.G. (M. V. Lomonosov Moscow State University). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **2**: No. 10, 339-340(Oct 1976).

The emission spectra and energy per unit volume of a copper vapor laser is studied for a laser in which a high vapor density is produced by exploding wires.(AIP)

40033 Condition for population inversion in Gunn diodes. Arutyunyan, V.M.; Varosyan, A.G. (Institute of Radiophysics and Electronics, Academy of Sciences of the Armenian SSR, Ashtarak). *Sov. Phys. - Semicond. (Engl. Transl.);* **11**: No. 2, 167-170(Feb 1977).

The population inversion condition was analyzed on the basis of the experimental data for GaAs and InP at 77 degreeK. The ratio J/J_0 of the current J capable of producing stimulated emission after impact ionization in a domain to the valley current J_0 was determined as a function of the donor concentration for real Gunn diodes. The dependences of J/J_0 on the length of the sample and the minority-carrier lifetime for a fixed electron density were also determined. It is shown that the shorter the sample and the longer the minority-carrier lifetime, the more difficult it is to obtain stimulated emission from Gunn diodes.

40034 Polarization-selective laser mirror. Firester, A.H. (to RCA Corp.). US Patent 4,009,933. 1 Mar 1977. Filed date 7 May 1975. 4p.

An optical substrate has an electrically conductive grating on one surface. A multilayered dielectric coating is applied over the grating.

40035 Laser alignment system. Hernqvist, K.G. (to RCA Corp.). US Patent 4,010,363. 1 Mar 1977. Filed date 31 Oct 1975. 4p.

A gas laser has a tube for producing a laser beam and a plurality of heaters around the tube. A detector responds to a misalignment of the laser sending a response to control circuits for the heaters. In response to the detector's output, the heater control circuits regulate the heaters so as to heat selective portions of the tube. The tube bends due to the heat resulting in a realignment of the laser. 9 claims, 3 figures.

40036 Flashlamp triggering arrangements for pressurized gas cooled lasers. Hon, D.T. (to Hughes Aircraft Co.). US Patent 4,010,397. 1 Mar 1977. Filed date 30 Oct 1975. 8p.

Series and shunt flashlamp triggering arrangements are disclosed wherein an electrically conductive patch is intimately bonded to a portion of the outer lateral surface of the flashlamp housing extending over a portion of the high voltage electrode and terminating at a longitudinal location along the housing substantially aligned with the inner end of the high voltage electrode. An electrically conductive wire connected to the patch extends along the outer lateral surface of the housing from the patch to at least the vicinity of the outer electrode. The high voltage electrode defines a sharp-edged annular rim projecting outwardly from its lateral surface adjacent its inner end.

40037 Laser output control system. Douglas-Hamilton, D.H.; Hoag, E.D. (to Avco Everett Research Lab., Inc.). US Patent 4,010,427. 1 Mar 1977. Filed date 8 Mar 1976. 16p.

A method and apparatus for controlling the power of a laser beam issuing from a gaseous working medium in a working region where the gas is subjected to an electric field and an ionizing beam is directed to the gas, ionizing the gas and producing secondary electrons sufficient to support laser action are described. The power of the laser beam is controlled by controlling the power of the electron beam. The electron beam power is controlled by an electrical feedback signal from a radiation detector that detects a fraction of the laser beam reflected from a plurality of reflective small wires carried by a rotatable hub which causes the wires to sequentially pass through the laser beam and reflect a small fraction of the laser beam towards the radiation detector.

40038 Radial flow laser. Falk, T.J. (to Calspan Corp.). US Patent 4,011,522. 8 Mar 1977. Filed date 6 Feb 1974. 12p.

A laser having a radial flow configuration which may be utilized to achieve lasing in both chemically and electrically excited gas lasers is described.

40039 High powered laser. Kantrowitz, A.R.; Gerry, E.T.; Leonard, D.A.; Wilson, J. (to Avco Corp.). US Patent 4,011,521. 8 Mar 1977. Filed date 16 Feb 1967. 18p.

In the laser, a gaseous mixture is suitably heated to a first tempeature and at a first pressure to provide a large energy content. The gaseous mixture comprises a polyatomic gas such as carbon dioxide having an upper level, ground state, and intermediate level. It also comprises at least one auxiliary gas such as nitrogen, having an energy level substantially resonant with one of the above-mentioned levels and a relaxation time operative to increase the ratio of the relaxation time of the upper level to that of the lower level. A chamber receives the mixture via a supersonic nozzle proportioned to provide a flow time short compared to the relaxation time of the upper level and long compared to the relaxation time of the lower level and the gas is throttled to a relative low second gas temperature and pressure, whereby population inversion exists in the chamber. An optical resonator defines a light path beam through the gaseous medium in the chamber.

40040 Gas laser generator. Godard, B. (to Compagnie Generale d'Electricite). US Patent 4,011,525. 8 Mar 1977. Priority date 21 Jan 1975, France. 6p.

Gas laser generator comprising a gaseous active medium, at least one electric excitation line formed by an insulating plate inserted between a first and second metallic plate, the first plate having a slot enclosing the gaseous medium, a circuit for setting up a progressive current wave in the line is described. The plates are cut in the shape of superimposed half parabolas. A variant consists in producing the generator in the form of two half parabolas such as above but insulated from each other and brought to different potentials. The invention is implemented in high-power lasers.

40041 X-ray generator. McKnight, W.B.; Scully, M.O.; Louisell, W.H. (to Secretary of the Army). US Patent 4,012,640. 15 Mar 1977. Filed date 30 Aug 1973. 2p.

A population inversion is established by beam foil excitation. A beam of completely stripped nuclei is passed through a foil target. An ion beam travels between the plates of a strip transmission line in a plane parallel to those plates. The foil is located in a slot in one of the plates. A voltage pulse is applied at the downstream end of the line and a wavefront propagates down the plates towards the upstream end. This pulse will cause deflection of the ion beam towards the foil along a linear intersection path which travels at approximately the velocity of light.

40042 Ion densities in a positive column He-Cd$^+$ laser discharge. Mori, M.; Takasu, K.; Goto, T.; Hattori, S. (Department of Electronics, Nagoya University, Nagoya, Japan). *J. Appl. Phys.;* **48**: No. 6, 2226-2230(Jun 1977).

By combining the modified absorption method with the modified double-probe method, the He$^+$ and Cd$^+$ ion densities in a cataphoresis type of positive column He-Cd$^+$ laser discharge were separated without using the Cd$^+$ ion mobility. They agreed with the He$^+$ and Cd$^+$ ion densities calculated on the basis of the electron energy distribution function in the He-Cd discharge well.

40043 Coupled electron photon collisional transport in externally applied electromagnetic fields. Halbleib, J.A. Sr.; Vandevender, W.H. (Sandia Laboratories, Albuquerque, New Mexico 87115). *J. Appl. Phys.;* **48**: No. 6, 2312-2319(Jun 1977).

The model presented describes the time-independent production and transport of the electron/photon cascade in two-dimensional cylindrical material/void configurations in the presence of static electromagnetic fields of arbitrary spatial dependence. The range of phenomena that can be studied with the model is carefully delineated. The underlying assumptions required for coupling condensed-history collisional Monte Carlo with macroscopic field transport are set forth in detail. The method is applied to specific problems in electron-beam-excited high-pressure gas laser research, high-intensity flash x-ray source development, and electron-beam-fusion research. Results are compared with the predictions of earlier theoretical models and with experimental data. Comparisons between the theoretical models clearly demonstrate the importance of the additional capabilities achieved in the model described here. Because of the complexity of the experiments, comparisons between the theoretical predictions and the experimental data are not especially definitive; where comparisons are possible, however, there appears to be at least qualitative agreement.

40044 Analytical solutions for laser heating and burnthrough of opaque solid slabs. Harrach, R.J. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *J. Appl. Phys.;* **48**: No. 6, 2370-2383(Jun 1977).

The thermal response of an opaque solid slab exposed to intense laser radiation is described using the heat-balance integral method. Approximate analytical solutions are obtained for the one-dimensional temperature distribution T (x,t), for the velocity x/sub s/(t) of the moving vapor-phase boundary, and for various characteristic quantities such as the front-surface vaporization time t/sub v/ , the time t/sub l/ required for heat to diffuse through the sample to the back surface, and the slab burnthrough time t/sub BT/. Account is taken of the influence on t/sub l/ and t/sub BT/ of partial vaporization of the target material. The thermophysical properties of the target are assumed to be constant independent of temperature, but the theory accommodates a time-varying laser intensity and a temperature-dependent surface absorptivity. Illustrative calculations are presented which compare the results of this theory to those derived from heat-transfer computer programs. These include a treatment of laser heating of an aluminum slab with temperature-dependent absorptivity and calculations of the time required to burn through aluminum, stainless-steel, and carbon-phenolic targets, covering a wide range of values of target thickness and laser intensity.

40045 Intense tunable ir generation by four-photon mixing in germanium. Lee, N.; Aggarwal, R.L.; Lax, B. (Francis Bitter National Magnet Laboratory, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *J. Appl. Phys.;* **48**: No. 6, 2470-2476(Jun 1977).

We have considered the method of noncollinearly phase-matched four-photon mixing of CO_2 laser beams in germanium at room temperature for the generation of intense tunable or quasitunable pulses of infrared radiation. Our theoretical analysis shows that it should be possible to obtained output intensities of multi-MW/cm^2 in the 8-μm region with conversion efficiencies as high as 37%. In the initial experiments reported here, we have observed as much as 33 mJ of energy per pulse (corresponding to a peak pulse intensity of $\sim$0.3 MW/cm^2) at 8.6 μm from a 10-cm-long antireflection(AR) - coated crystal using CO_2 laser beams of $\sim$10-MW/cm^2 intensity. This corresponds to a conversion efficiency of $\sim$1%. We have also examined several other practical aspects of this four-photon mixing technique. Use of single-mode CO_2 lasers should provide a step-tunable ir radiation with linewidth much less than 0.01 cm^{-1}. A simple analysis of the heat dissipation from the germanium crystal into a copper block indicates that the temperature rise is only a few degrees even at pulse repetition rates of several hundred Hz. Thus, the noncollinear four-photon mixing scheme should find important applications in laser photochemistry.

40046 Measurement of the gain profile of high-pressure Kr/O_2 mixtures near 5577 A. Woodworth, J.R.; Rice, J.K. (Sandia Laboratories, Albuquerque, New Mexico 87115). *J. Appl. Phys.;* **48**: No. 6, 2502-2504(Jun 1977).

An intense relativistic electron beam (1.8 MeV, 100 ns, 4 kJ) was used to transversely excite a 50-cm-long laser cell containing 5200 torr krypton and 10 torr O_2. Optical gain in the medium in the afterglow of the e-beam pulse was determined by measuring the decay of a 5-ns-long pulse from a carefully wavelength-tuned (+- 0.1 A) narrow-band (0.04 A FWHM) dye laser which was trapped in the test cell by two highly reflecting mirrors. The peak gain occurs at 5578.4 +- 0.2 A, 1.1 A on the red side of the O(2^1Syields2^1D) transition. The half-width of the gain profile is 1.5 A and the profile is completely dominated by KrO quasimolecules.

40047 Optically cascaded pulsed DF chemical laser. Osche, G.R. (U. S. Army Electronics Command, Fort Monmouth, New Jersey 07703). *Appl. Phys. Lett.;* **31**: No. 1, 29-31(1 Jul 1977).

The optical extraction efficiencies and temporal characteristics of a pulsed optically cascaded SF_6+D_2 chemical laser are presented. It is shown that the directly coupled cascade $P_3(7)$ yields$P_2(8)$ yields$P_1(9)$ yields approximately 53% of the total multiline energy, while the rotationally coupled cascade $P_3(6)$ yields$P_2(8)$ yields$P_1(10)$ and the mixed cascade $P_3(6)$ yields$P_2(8)$ yields$P_1(9)$ are slightly less efficient. Cavity parameters, relative emission strengths, and natural delay times for oscillation of P lines are shown to have a strong influence on the total peak power.

40048 vuv emissions from mixtures of F_2 and the noble gases: A molecular F_2 laser at 1575 A. Rice, J.K.; Hays, A.K.; Woodworth, J.R. (Sandia Laboratories, Albuquerque, New Mexico 87115). *Appl. Phys. Lett.;* **31**: No. 1, 31-33(1 Jul 1977).

We have observed two new emission features in electron-beam-excited mixtures of molecular fluorine with either neon or helium. One feature is a continuum centered at 1080 A which we attribute to NeF*. The other emission feature is a band system extending from 1500—1600 A which we attribute to a transition of molecular fluorine. This transition lased near 1575 A.

40049 Efficient Raman shifting of ArF and KrF laser wavelengths. Loree, T.R.; Sze, R.C.; Barker, D.L. (University of California, Los Alamos Scientific Laboratory, P. O. Box 1663, Los Alamos, New Mexico 87545). *Appl. Phys. Lett.;* **31**: No. 1, 37-39(1 Jul 1977).

A series of uv lines has been generated in the region 190—360 nm by multiple Raman scatterings of the ArF and KrF laser wavelengths. ArF has been shifted in H_2 and KrF shifted in H_2, D_2, and CH_4. For the optimized case of KrF pumping H_2, better than 50% energy conversion was observed to the first Stokes at 2769 A.

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 39090, 39431, 39444, 40005

40050 (LBL—5582) Numerical investigation of confined turbulent shear flows. Bernard, P.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1976. Contract W-7405-ENG-48. 162p. P 08/MF A01.

Thesis.

The first objective of this work is to present a new derivation of the method of coarse graining for the computation of turbulent flows, one which strengthens and clarifies its theoretical foundation. Secondly, we show by the application of this method to the study of the turbulent flow in a channel and behind a piston in compressive motion that a promising start has been made toward acquiring the ability to predict the mean properties of turbulent flows. The work presented here is primarily concerned with two dimensional flow. The principal improvement in the method of coarse graining consists of the establishment of a new general law of turbulent diffusion which applies to any scalar that is passively convected in a turbulent flow. The law is in the form of an expansion in roughly the Lagrangian integral time scale. The transport law is used to derive a closed set of equations for the mean vorticity and mean squared fluctuating vorticity. Other innovations include a more precise accounting of the effects of the local turbulence on the velocity moments and the use of an explicit equation for mean squared fluctuating vorticity instead of mean squared vorticity.

40051 Acceleration waves and mild discontinuities in a nonsimple mixture of chemically reacting elastic materials. Nunziato, J.W.; Walsh, E.K. (Sandia Labs., Albuquerque, NM). *Arch. Ration. Mech. Anal.;* **58**: No. 2, 115-126(1975).

A theory of nonsimple, chemically reacting elastic materials without diffusion is developed allowing the response functions to depend on the second-gradient of the deformation and, for simplicity, assuming that the mixture is a nonconductor of heat..

40052 (INEL-TR—10) Use of miniature optical probes in two-phase gas-liquid flow. Application to measurement of local void fraction and local gas velocity. Galaup, J.P.; Delhaye, J.M. Translated from *Houille Blanche;* **31**: No. 1, 17-30(1976). 29p. P 03/MF A01.

The development and testing of an optical probe for measuring local void fraction and gas velocity in bubbly, bubbly-slug and slug flows is discussed. Previous studies of the use of optical probes for studying two-phase flow are reviewed. The equipment and procedures used in this study are described. Void fraction measurement results are compared with the total average void fraction measured along the same diameter by a γ-ray absorption method. Gas velocity measurements are compared with turbine flowmeter measurements of volume flow rate. It was concluded that the optical probe used in this study is useful in the study of the local structure of two-phase flows, that a simple single probe permits measurement of the void fraction of one of the phases in a two-phase medium where the liquid is not an electrical conductor, and that a double probe with two sensing elements can be used to estimate the local velocity of the gaseous phase. (LCL)

40053 Zhidkometallicheskie teplonositeli. (Liquid metal coolants). Borishanskii, V.M.; Kutateladze, S.S.; Novikov, I.I.; Fedynskii, O.S. (eds.). Moscow; Atomizdat (1976). 328p.

Theoretical and experimental data on heat transfer, hydraulic properties, and uses of liquid metals are presented. The theory of convective heat transfer is examined in detail and peculiarities of convective heat transfer in liquid metals are examined. Experimental data on heat transfer with liquid metals in equipment of various configurations, e.g., channels, pipes, annular spaces, are discussed. Special attention is paid to the physical properties, chemical properties, and purification of liquid metal heat conductors. (LCL)

40054 Heat transfer calculations using finite difference equations. Croft, D.R.; Lilley, D.G. London; Applied Science Publishers Ltd. (1977). 294p. $32.00.

A comprehensive and illustrated account of the use of finite difference computational methods for heat transfer calculations is presented. The methods are basically simple but offer a powerful tool to the engineering designer or researcher faced with heat transfer problems of a difficult, or more often impossible, analytical nature. The text is oriented towards the practical man who needs a complete work to enable him to understand and apply the methods to solve his problems. Information is provided about all the many facets of analyzing and solving conductive heat transfer problems, including the computer programming aspects. The general problem considered is that of calculating the distribution of temperature or temperature history in a physical system in which heat transfer is taking place. A special attribute offered is the strong practical emphasis, and recent ideas on numerical solution techniques, and their implementation via Fortran computer programs. The various numerical solution schemes are illustrated through a series of worked examples, tabular computations, Fortran programs and case studies.

40055 Turbulent heat transfer studies in annulus with inner cylinder rotation. Kuzay, T.M.; Scott, C.J. (Technical Staff Member, Argonne National Laboratory, Argonne, III. Mem. ASME). *J. Heat Transfer;* **99**: No. 1, 12-19(Feb 1977).

Experimental investigations of turbulent heat transfer are made in a large-gap annulus with both rotating and nonrotating inner cylinder. The vertical annular channel has an electrically heated outer wall; the inner wall i thermally and electrically insulated. The axial air flow is allowed to develop before rotation and heating are imparted. The resulting temperature fields are investigated using thermocouple probes located near the channel exit. The wall heat flux, wall axial temperature development, and radial temperature profiles are measured. For each axial Reynolds number, three heat flux rates are used. Excellent correlation is established between rotational and nonrotational Nusselt number. The proper correlation parameter is a physical quantity characterizing the flow helix. This parameter is the inverse of the ratio of axial travel of the flow helix in terms of hydraulic diameter, per half revolution of the spinning wall.

40056 Bubble formation and heat transfer during dispersion of superheated steam in saturated water. I. Bubble size and bubble detachment at single orifices. Schmidt, H. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.). *Int. J. Heat Mass Transfer;* **20**: No. 6, 635-646(Jun 1977).

Despite the high practical importance of heat and mass transfer between fluid phases the relevant data are not well known due to the multitude of parameters affecting this phenomenon. Part of this extended problem is dealt with by restriction on the events taking place during bubble formation at single orifices. The experimental investigation of bubble formation and detachment from single submerged orifices at high system pressures and temperatures is described, and the corresponding heat transfer is investigated. The experiments are carried out in the steam—water system. The superheated steam is injected through 1.5, 2 and 3 mm dia orifices from a 5 cm^3 antechamber into demineralized saturated water. The steam flow rate is varied in the range of 2 to 20 g/min, the maximum pressure is 212 at. The steam temperature differences related to the corresponding boiling temperatures are 100, 150, and 200 K. The experimental observations are interpreted by means of dimensional analysis. The following results are obtained: Relations are pointed out between the bubble shape as well as the formation frequency and the physical parameters of the system. The relevant effect on transition from steady-state bubble formation (single bubble formation) to unsteady-state bubble formation (coalescence of the bubble during detachment) is found to be a problem of eigenoscillation of the bubble.

40057 Bubble formation and heat transfer during dispersion of superheated steam in saturated water. II. Heat transfer from superheated steam bubbles to saturated water during bubble formation.

Schmidt, H. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.). *Int. J. Heat Mass Transfer;* **20**: No. 6, 647-654(Jun 1977).

In evaporators, which are characterized by introduction of superheated steam into water to be evaporated, the steam is distributed over so-called nozzle plates. The steam is introduced into water through a multitude of cylindrical bores. Regarding the optimum construction of such evaporators, the minimum path of heat transfer is of interest, which is covered by the superheated steam bubbles until reduction of their superheat. On account of its magnitude the energy transport during bubble formation can become significant for the total transport of energy. In Part I a report was given of the formation of superheated steam bubbles, their size, shape and frequency of formation at high system pressure, and system temperature. Here the heat transfer during the period of bubble formation is described. In the range of system pressures considered in the experiment of 15 to 160 at a decrease in superheat temperature of 40 to 60 percent is measured during bubble formation. The average heat-transfer coefficients range from 0.05 to 0.75 W/cm²K. The heat transfer is indicated by a relation of the Stanton number as a function of the Reynolds number.

40058 Nucleate boiling in binary mixtures. Shock, R.A.W. (Atomic Energy Research Establishment, Harwell, Eng.). *Int. J. Heat Mass Transfer;* **20**: No. 6, 701-709(Jun 1977).

It is well established that many parameters associated with nucleate boiling of a mixture differ significantly from those for a pure fluid of identical physical properties. Some attribute this difference to changes in bubble growth rates due, ultimately, to a resistance to the interdiffusion of the species. Others suggest that the change is due to differences in the superheat required to initiate bubble growth due, ultimately, to changes in the parameters governing the saturation pressure—temperature relationship. The latter theory is closely examined here and found to be untenable. It is, however, shown that in aqueous systems there may be an increase in the superheat required for the onset of nucleate boiling due to the effects of the change in wetting characteristics for organic solvents at low concentrations. Experimental data abstracted from the literature show that the diffusion resistance, which is found once boiling has commenced, still plays a significant role in the reduction in heat transfer in aqueous systems and it is presumed to be the controlling factor in non-aqueous systems.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 40719

40059 (Y—2075) **Study of the relationships of three factors on errors in inspection.** Leete, R.S. Jr.; Lever, W.E. (Oak Ridge Y-12 Plant, Tenn. (USA)). Apr 1977. Contract W-7405-ENG-26. 79p. P 05/MF A01.

Gaging errors can occur in any process of fabrication and inspection of product. There are two types of errors: (1) accepting product that should be rejected, and (2) rejecting product that should be accepted. Costs of these errors depend on how frequently they occur. The frequency of these errors (i.e., their probability of occurring) is a function of three factors: (1) specification limits (tolerance) of the feature being processed, (2) variability of the fabrication process, and (3) variability of the inspection process. With some basic assumptions, this report shows the likelihood of each type of gaging error for many combinations of these three factors. Thus, for example, with knowledge of the tolerance for a feature and an estimate of the variation of the fabricating process, a gage designer can objectively assess how critical his gaging repeatability is in terms of errors of inspection. This assessment should prove more cost effective than any rule of thumb such as "gaging repeatability should be 10 percent of the feature tolerance".

40060 Osnovy neitronnoi radiografii. (Principles of neutron radiography). Tyufyakov, N.D.; Shtan, A.S. Moscow; Atomizdat (1975). 256p.

The following information on neutron radiography is presented: physical principles; application for nondestructive testing of materials and of industrial products; characteristics of various neutron sources and their uses; equipment required; exposure measurements; analysis of neutron radiograms; sensitivity of neutron radiography for detecting defects in homogeneous and laminar materials; and the design of neutron radiography equipment. (LCL)

40061 High-speed surface flaw inspection. Reich, F.; Coleman, W.J. (Battelle Pacific Northwest Labs., Richland, WA). *Opt. Eng.;* **15**: No. 1, 48-51(1976).

An optical surface flaw inspection monitor has been developed as a part of Frankford Arsenal's Cartridge Case Measurement Eject System for 5.56 mm small-caliber ammunition. This surface flaw monitor uses scattered light electro-optical instrumentation to detect flaw presence on 100 percent of the cartridge case surface at case throughput rates exceeding 1200 cases/minute. A line source formed from a laser source with cylindrical optics automatically tracks a spinning cartridge on the perimeter of a wheel-type mechanical handling system. Individual fiber optic elements located at each case position direct scattered light from surface zones of the case to common photomultiplier-based optical detectors. The detected signals are corrected for illumination and receiving optics transmissions and then frequency-processed. The frequency pattern of the detected scattered light relates directly to the type of surface flaw, such as dents and scratches. Go/no-go signals are fed directly to a minicomputer for implementation of a reject function on the mechanical handling hardware.

40062 Radiographic screen with improved resolution. Swank, R.K. (to General Electric Co.). US Patent 4,012,637. 15 Mar 1977. Filed date 5 May 1975. 10p.

A conventional x-ray screen-film system includes a phosphor intensifying screen "sandwich", including a backing layer facing the x-rays, the phosphor layer itself, and a so-called "overlayer" adjacent the photographic film. X-rays passing through the backing cause scintillations within the phosphor, emitting light photons which, in turn, pass through the overlayer, a small air gap (caused by lack of perfect optical contact of the overlayer and the adjacent surface of the film) and into the film so as to form a latent image on the photographic film. The present change involves making the overlayer partially light absorbing so that those light photons which, for example, have been totally internally reflected at the overlayer to air gap surface, returned into the phosphor and then scattered out again through the overlayer, will be absorbed to a much larger extent than those light photons which travel more or less directly from their point of origin through the overlayer into the film, since the indirectly transmitted photons will travel through the overlayer at least three half-trips (at least two of which will be at a substantial angle and therefore through a relatively long path). This selective absorption of the long-path light photons substantially increases the resolution of the screen-film system without adversely affecting the signal-to-noise ratio (in particular, the quantum mottle).

SAFETY ENGINEERING

40063 Humidity effect in the flow resistance of loaded fibrous filters. Franklin, H.; Knutson, E.O.; Hinchliffe, L.E. (Health and Safety Lab., New York). *Atmos. Environ.;* **10**: No. 10, 911-912(1976).

A pronounced effect of humidity on the flow resistance of fibrous filters loaded with a hygroscopic aerosol was encountered. Four-cm Hollingsworth 5G fibrous filters were loaded with dry uranine aerosol causing the pressure to drop exponentially with time. Then filtered humid air was passed through the filter causing a sharp drop in filter flow resistance. Dry air flow caused no change. The mechanism of this effect is not yet established but a working hypothesis is described.

ELECTRONIC CIRCUITS AND DEVICES

40064 (SAND—77-8503) **Use of a microprocessor-based interactive system to increase production of printed wiring board artwork.** Hopwood, J.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1977. Contract EY-76-C-04-0789. 71p. P 04/MF A01.

A microprocessor-based, stored-program controller was developed to format output data from a coordinate digitizer and transmit it to a remote computer, and eliminate thereby manual handling of punched cards. The instrument, known as the digitizer interactive processor, has greatly improved the efficiency of producing artwork for printed wiring boards. 16 figures.

40065 (UCRL—52228) **Analysis of wire antennas in the presence of a conducting half space. Part III. The buried antenna.** Miller, E.K.; Deadrick, F.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Feb 1977. Contract W-7405-ENG-36. 39p. P 03/MF A01.

The report extends an earlier one dealing with the reflection coefficient approximation (RCA) for modeling objects located near an interface between electrically different half spaces. The procedure to handle objects on opposite sides of the interface is described. The method, which is denoted as the transmission coefficient approximation (TCA), is based on a ray-optics formulation and an assumed reciprocity along a given ray path. An integral-equation, moment-method technique for wires, when combined with the RCA-TCA, permits modeling the response of antennas above ground to buried objects. Similar problems of geophysical interest, as well as those of the more conventional antenna interface, may also be modeled. Sample results to illustrate how the technique may be applied are presented. A comparison of results is made between the RCA-TCA and those obtained from a rigorous treatment based on the Sommerfeld integrals to demonstrate the validity of the approximate approach. The approximate approach offers much greater

efficiency (approximately 50 times faster) relative to the rigorous approach.

SOLID WASTE PROCESSING PLANTS AND EQUIPMENT

REFER ALSO TO CITATION(S) 39460, 39757, 39758, 39759

40066 Simulation of a sludge incineration, drying, and waste heat recovery process. Barker, R.M.; Vosseller, G.V. (Toltz, King, Duvall, Anderson, and Associates, Inc., St. Paul). pp 195-200 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

One portion of the program for expanding the Minneapolis/St. Paul wastewater treatment facility was to develop a facility for processing the sludge produced by the primary and secondary treatment of the wastewater. It was decided that the best solution would be offered by a process which incorporated incinerators, waste heat boilers, dryers, and a pyrolysis unit which would utilize a mixture of sludge and municipal solid waste to generate useful solid and gaseous fuels. In order to study the interaction between the components in the system and to assist in their design, a computer program was developed to simulate the process. The simulation model is described under the following headings: process description, basic relationships between components, search procedure for maximum steam, and results of the study. Finally, conclusions are drawn concerning the advantages of having additional information provided by computer simulation when designing and operating an interactive sludge disposal facility.

40067 Separation of municipal solid wastes. Shiomi, H.; Nagahara, K.; Sato, T.; Tokoro, K.; Yoshimoto, M. *Kawasaki Giho;* No. 62, 258-266(Dec 1976). (In Japanese).

To investigate the feasibility of managing and recycling solid wastes, separation tests under vibrating and air separation principles were carried out on household and incombustible wastes. Separation test results were favorable, i.e., (1) household wastes could be separated into several material groups, such as plastics, paper and garbage; and (2) from incombustible wastes, glass and ferrous metals were recovered in high purity. These test results and feasible resource recovery systems derived from these tests are described.

40068 Development of car shredding plant. Watanabe, K.: Ijuin, M.; Ohashi, J.; Takahashi, H.; Yamamuro, H.; Fukunishi, T.; Sato, Y.; Ogawa, M. *Kawasaki Giho;* No. 62, 361-367(Dec 1976). (In Japanese).

The development of a car shredding plant which recycles used cars into high quality scrap metal through crushing and separation processes is discussed. The special design of the car shredder, prevention of vibration, noise, and dust pollution in the plant are described. The explosion problem caused by explosive material handling is also examined.

40069 Apparatus and process for the pyrolysis of waste solids concentrates. Greenfield, C.; Casparian, R.E.; Bonanno, A.J. (to Hanover Research Corp.). US Patent 4,013,516. 22 Mar 1977. Filed date 13 Mar 1975. 16p.

Apparatus and a process for the thermal decomposition of organic material is disclosed wherein the waste solids concentrates are first mixed in a fluidizing tank with a fluidizing oil to form an appropriate mixture which is then dehydrated to remove water from the waste and oil mixture. Subsequently, the waste solids and oil are separated. The resultant dehydrated, substantially oil-free organic waste material is then pyrolized within a temperature range of approximately 700°F to 1800°F by which lower molecular weight organic compounds are distilled off as organic vapors and gases while a residue of char and ash remains.

40070 Apparatus for recycling filtration media. Arvanitakis, K.S. US Patent 4,014,790. 29 Mar 1977. Filed date 30 Sep 1975. 4p.

A filtration system discharging dry sludge material comprising filter aid material and contaminants removed from the liquid which have all been subjected to heat and mechanical action is described. These materials are conveyed from the discharge of the filtration system to a feeder for controlled introduction into the filtration system as necessary, or for disposal or reclamation.

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 39167, 39744, 39745, 39998

40071 (TID—27509) Gas-solids regimes in the distribution region of a fluidized bed. Vines, S.N. (Virginia Univ., Charlottesville (USA). School of Engineering and Applied Science). Jan 1977. Contract EX-76-S-01-2451. 200p. P 09/MF A01.

Thesis.

Fluidized beds consisting of solid particles suspended in a counter gravity flow of gas are widely utilized in the petroleum, chemical and metallurgical industries and are proposed for coal combustion and gasification. It is widely recognized that the method used to introduce the fluidizing gas affects the chemical performance of the fluidized bed. However, little is known about the distribution region of an industrial fluidized bed which contains non-moving solids, moving but non-fluidized solids, emulsion (bubble free) fluidized solids, bubble regime fluidized solids and gas jets. There are significant differences in heat transfer coefficients in the several gas-solid regimes of a fluidized bed. This characteristic was utilized in the development of a miniature, self-heated thermistor probe to discriminate among the several gas-solid regimes in the gas distribution region of a fluidized bed. A miniature, self heated thermistor probe was fabricated, calibrated and its use successfully demonstrated in the investigation of a fluidized bed. Well defined regime interfaces were observed for upflow air entry. In the case of downflow air entry, a turbulent unsteady state was observed and the fluidized regimes were poorly defined. A wall effect on regime interfaces was evident in the 3.44 inch diameter unit by comparison with the 5.2 inch diameter unit. The angle of the top interface of the non-moving solids surrounding the air entry was significantly larger than the angle of repose of the solid particles. The angle of the lower interface of the bubble regime appeared to approximate the angle of internal friction of the solid particles. This new tool and the technique for its use will be of value in extending knowledge of the extent of the several gas-solid regimes in fluidized beds. It can also be used to test theoretical and empirical models of the distribution region as they are proposed.

40072 Fluidisation and gas combustion in a rotating fluidised bed. Metcalfe, C.I.; Howard, J.R. (Univ. of Aston, Birmingham, Eng.). *Appl. Energy;* 3: No. 1, 65-74(Jan 1977).

The background against which this novel type of high intensity combustor is being developed is described. Some of the design, development and operating problems involved are reported. Conditions for satisfactory fluidization of the particles and combustion of propane within a rotating fluidized bed are outlined. Running experience shows that stable, complete combustion of propane can be sustained at intensities exceeding 85 MW /m³ of bed particles when a centripetal acceleration of ten times gravity is applied to a shallow bed of particles without an unacceptable pressure drop.

40073 Reduction of gaseous pollutants in combustion flue gas. Craig, G.D.; Feuling, D.T.; LeHaye, P.G. (to Aqua-Chem, Inc.). US Patent 4,013,399. 22 Mar 1977. Filed date 9 Oct 1975. 8p.

Fuel is burned in a primary combustion chamber with less than the air required for stoichiometric combustion so that the combustion gases have a high carbon monoxide (CO) and hydrocarbon content and the temperature of the gases is held below that at which significant nitrogen oxides (NO/sub x/) would be produced. The combustion gases are then passed through a secondary combustion zone in which more air is injected into the gas stream to oxidize the CO and hydrocarbons to carbon dioxide (CO_2). The secondary burner comprises a plurality of foraminous tubes through which secondary air is emitted. Combustion in the secondary zone is maintained at a temperature below that at which nitrogen oxides (NO/sub x/) will be produced in significant quantities.

MARINE ENGINEERING

REFER ALSO TO CITATION(S) 39199, 39769

40074 Ocean engineering mechanics. Monney, N.T. (ed.). New York; American Society of Mechanical Engineers (1975). 152p. (CONF-751106—P1). $20.00.

From Annual meeting of ASME; Houston, Texas, USA (30 Nov 1975).

Nine papers were presented at the conference. A separate abstract was prepared for each of 4 papers. (RCK)

40075 Some resonant vibration properties of marine cables with application to the prediction of vortex-induced structural vibrations. Ramberg, S.E.; Griffin, O.M.; Skop, R.A. (Naval Research Lab., Washington, DC). pp 29-42 of In Ocean engineering mechanics. Monney, N.T. (ed.). New York; American Society of Mechanical Engineers (1975).

From Annual meeting of ASME; Houston, Texas, USA (30 Nov 1975).

See CONF-751106—P1.

Some ocean-based facilities which may be subjected to vortex-induced structural vibrations include oil jetties and terminals,

drilling platforms, and mooring cable systems. As part of an ongoing program to develop a semi-empirical model for predicting these flow-induced vibrations of flexible structures and cable systems, an investigation was made of some pertinent resonant vibration properties of stranded steel-wire and synthetic-fiber marine cables. In-water damping and virtual mass measurements were made over a frequency range of from 3 to 100 Hz and for up to three modes of vibration. The in-water damping and virtual mass exhibit no measurable dependence on amplitude (up to vibrations of a full cable diameter), mode shape and wave length. Also, the damping and virtual mass were found to be only slightly dependent on the vibration frequency over the range of parameters investigated. The vortex-induced crossflow response of cylindrical structures is governed by a response parameter or reduced damping coefficient which is related to the damping and virtual mass of the structure. The cable response parameters measured during the present investigation are utilized in the demonstration of a method for predicting the periodic, vortex-induced motions of marine cables.

40076 Ocean test structure program. Haring, R.E. (Exxon Production Research Co., Houston, TX). pp 123-132 of In Ocean engineering mechanics. Monney, N.T. (ed.). New York; American Society of Mechanical Engineers (1975).

From Annual meeting of ASME; Houston, Texas, USA (30 Nov 1975).

See CONF-751106—P1.

The Ocean Test Structure Program is a large-scale engineering experiment designed to improve understanding of ocean wave loading on conventional space-frame structures used for continental shelf development of oil and gas resources around the world. The horizontal design load on these structures, which determines the required size and thickness of the framing members and the depth of pile foundations, is principally due to drag forces under the crests of large waves. Present total wave force estimates on space-frame structures are based on interpretations of single-pile force measurements using simplified theories. Industry design practices which result are regarded by many as conservative based on the available data. Exxon Production Research Company has designed an ocean test structure for the purpose of acquiring benchmark data which can be used to evaluate present design force calculation procedures and to refine those procedures. Based on the resulting data, industry could move away from costly conservatism where it exists, and in any case possess a more quantitative basis for setting required platform strength levels. The test structure will provide a replica of flow conditions encountered in design level seastates in reduced scale, about $1/3$ to $1/6$ the size of full-scale oil and gas platforms. The planned measurements will permit direct comparison between actual and predicted forces on the structure under conditions simulating design wave loading for any continental shelf area.

40077 API recommended practice for planning, designing, and constructing fixed offshore platforms. Dallas; American Petroleum Institute (1976). 47p. (NP—21797).

This Recommended Practice for Planning, Designing, and Constructing Fixed Offshore Platforms contains engineering design principles and good practices that have evolved during the development of offshore oil resources. Good practice is based on good engineering; therefore, this recommended practice consists essentially of good engineering recommendations. In no case is any specific recommendation included which could not be accomplished by presently available techniques and equipment. Consideration is given in all cases to the safety of personnel, compliance with existing regulations, and antipollution of water bodies. Offshore technology is growing rapidly. In those areas where the committee felt that adequate data were available, specific and detailed recommendations are given. In other areas general statements are used to indicate that consideration should be given to those particular points. Designers are encouraged to utilize all research advances available to them. As offshore knowledge continues to grow, this recommended practice will be revised.

40078 Wave forces on cylinder submerged horizontally in shallow water. Mitani, H.; Sasaki, K.; Kobayashi, T.; Nomura, N.; Kawabe, H.; Sugimoto, H. *Kawasaki Giho;* No. 62, 68-77(Dec 1976). (In Japanese).

To estimate the wave forces on offshore and/or coastal structures, the ideal method is undoubtedly to obtain the more accurate solution of hydrodynamic equations under suitable boundary conditions. However, in practice, it is difficult to introduce precise solutions under present technical levels because some important problems still remain. Among them is the unsteady boundary layers with separation around the objects. Consequently, every effort is being made in this field to approximate these conditions. Among these approximations, the Diffraction Wave Theory and the Morrison's Method are the most famous means in practice, although both still have some problems. Some problems with the traditional Finite Amplitude Wave Theories such as Stokes and Cnoidal Wave Theories are examined, and by applying additional computed results to the Morrison's formula, the estimated formula for wave forces on a cylinder submerged horizontally in shallow water is introduced. Subsequently, the applicability of the formula and also the specific characteristics of wave forces on a horizontally settled cylinder are investigated in detail, attaching first importance to the distinctions from the vertically settled cylinder, based on the comparison of computed results with experimental results. The experiments were carried out on two different diameters of cylinder, 70 mm and 140 mm, and bottom slopes of the experimental tanks, $1/100$ and $1/30$, under various conditions varying water depth, wave period, wave height and also setting position of cylinder.

40079 Piping thermal stress analysis program. Onoda, R.; Kudai, T.; Sekihara, T.; Mayu, H.; Ohya, T. *Kawasaki Giho;* No. 62, 98-102(Dec 1976). (In Japanese).

This program was developed for the design of low-temperature piping of LNG carriers and main steam piping of high power turbine ships. This program, which makes use of the stiffness matrix method, is capable of analyzing piping flexibility in various conditions of temperature, concentrated load, distributed load, axial force by internal pressure in piping, permanent set and spring hanger, within the range of 200 nodes, 200 members and 19 blocks.

40080 Reasonable designing method for fillet welding leg length. Kiso, T.; Michiyuki, T.; Nagao, S.; Yoshikawa, M.; Miyazaki, S. *Kawasaki Giho;* No. 62, 138-143(Dec 1976). (In Japanese).

In VLCC and ULCC vessels, the scantling of structural members, especially the thickness of web plate, increases naturally. The present rule of each classification society generally prescribes that welding leg length should be based on the thickness of the web plate. Welding leg length between this web plate and skin plate such as shell plate, deck plate, etc., or face plate, increases according to increase of the thickness of the web plate. We investigated the method to decide reasonable welding leg length and its programming by using the results of finite element method structural analysis, without adhering to the above rule about welding leg length. As a result of applying this method to actual ships under classification societies' approval, the amount of welding decreased by from about 10 percent to 15 percent compared with that required by the above rule. The rationality of the method has been already confirmed by successful results of the application to several vessels in service.

PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 40545

DESIGN, DEVELOPMENT, AND OPERATION

40081 (BNL—22160) **Beams at U.S. high energy physics laboratories.** (Brookhaven National Lab., Upton, N.Y. (USA)). Jun 1976. Contract EY-76-C-02-0016. 7p. P 02/MF A01.

Tables are given of beam characteristics for particle accelerators at Argonne National Laboratory, Brookhaven National Laboratory, Cornell University, Fermi National Accelerator Laboratory, and the Stanford Linear Accelerator Center. Characteristics given include energy, momentum, and flux. (PMA)

40082 (BNL—50579, pp 285-298) **Present operational status of superconducting electron linear accelerators.** Smith, T.I. (Stanford Univ., CA). Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

At present two superconducting electron accelerators have been developed to the point of being operational, in the sense that they routinely produce beams of predictable, useful parameters. The two accelerators, the University of Illinois superconducting microtron, and the Stanford University superconducting recyclotron (linear accelerator with recirculation), are discussed. In addition to a description of these two machines some of the plans and lines of research at HEPL are discussed.

40083 (BNL—50579, pp 341-363) **Proposed kaon beam lines at KEK.** Hirabayashi, H.; Kurokawa, S.; Kusumegi, A. (KEK National Laboratory for High Energy Physics, Ibaraki, Japan). Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

The results of design study on the low momentum kaon lines at KEK are given. There will be two beam lines from the slow extracted proton beam for counter experiments in the experimental hall. One is a well separated variable acceptance kaon beam line, K2, of 27.9 m in the range of 1 to 2 GeV/c. The estimated K^+ flux at 2

GeV/c is 1.8 x $10^5/10^{12}$ protons of 12 GeV. The other is a large acceptance short length kaon beam line, K3, in the region of 0.5 to 1 GeV/c. The design is still tentative in the sense of not excluding the other possibility and further improvements. At present, the K3 beam line has a length of 13.56 m in which a magnet having n-value (1.724) and a pair of superconducting quadrupole magnets are included. The estimated flux of K^+ of 800 MeV/c is 2.0 x $10^5/10^{12}$ protons of 12 GeV.The time schedule of construction and a brief description of approved experiments with the beams are also given.

40084 (BNL—50579, pp 119-135) **Design of a new low momentum kaon beam for the AGS.** Lazarus, D.N. Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the Summer Study Meeting on Kaon Physics and Facilities.

It should be emphasized that the newly designed low momentum beam will be a unique source of antiprotons as well as kaons. The LESB II was designed with both species of particles in mind and neither category of potential users should feel their interests have been compromised. The goals for the new design were an order of magnitude increase in intensity over the present beam, LESB I (or C2, C4) with an improvement in purity that would not significantly increase the pion flux over what it is in the present beam which has a π^-/k^- ratio of ten to one. In designing a beam of this type for the AGS, one starts with several advantages in that kaon and, in particular, antiproton production by 28.5 GeV/c protons is significantly larger than at lower energy machines; the high intensity operation of the AGS with approximately 10^{13} protons every 2.4 seconds should make 2 x 10^{12} protons available in a one-second spill with little structure, and the small emittance of the extracted beam makes the use of small targets and hence small images possible.

40085 **Direct acting plasma accelerator.** Ress, T.I.; Nolde, G.V. (to Kreidl Chemico Physical KG). US Patent 4,010,396. 1 Mar 1977. Filed date 26 Nov 1973. 20p.

Charged particles are entrained on a straight or curved path by a traveling magnetic field moving along that path with its magnetic flux vector transverse thereto. The general direction of entrainment is the same for particles of either polarity. The initial relative velocity between the traveling field and the particle drives the latter into motions along a quasi-cycloidal trajectory in the direction of field travel at an average particle speed nearly equal to the field velocity. Streams of charged particles may be accelerated into streams separated from any material objects such as vessel walls, magnetic structures, electrodes, etc. This confinement is achieved predominantly by the balanced interaction of the forces exerted on the particles by the traveling magnetic field and their inertial forces. Auxiliary confining fields may be applied for redirecting to the main stream any particles scattered by secondary effects. The traveling field may be generated by a group of electromagnets, with or without cores, spaced along the path and excited in staggered phase relationship; by an angular offsetting of the polar axes of adjoining electromagnets, the quasi-cycloidal trajectories may be twisted into spacial curves designed to keep the particle stream within preselected boundaries without the need for separate magnetic focussing fields.

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

40086 (BNL—50579, pp 1-8) **Brief remarks on new kaon beams: what are the issues.** Barnes, P.D. (Carnegie Mellon Univ., Pittsburgh). Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

A brief review is given of the current status of and future needs for kaon beam experimental facilities. Topics include: (1) kaon fluxes now available; (2) beam requirements for various experiments; (3) new accelerators; and (4) some experiments which should included in the physics program. (PMA)

40087 (BNL—50579, pp 189-200) **Potential of existing synchrotrons.** Teng, L.C. (Fermi National Accelerator Lab., Batavia, IL). Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

The criteria to survey the potential of existing proton synchrotrons as kaon factories are described, including kaon momentum, kaon production spectrum, and kaon beam acceptance. The energy and intensity of kaon beams produced at existing proton synchrotrons are given. (PMA)

40088 (BNL—50579, pp 245-255) **Production of kaons at electron accelerators.** Gearhart, R.A. (Stanford Univ., CA). Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

The primary electron beam at SLAC has been variously used to produce secondary beams of both charged and neutral particles. Four general purpose charged particle beams are now in operation, each capable of useful kaon fluxes with the momentum range of several GeV/c. There is also a recently used neutral kaon beam which is now dormant. The measured yields together with the expected yields are reported. Empirical formulas have been fitted to the data to permit extrapolation of the measured yields to other electron energies and to other secondary momenta with some confidence.

40089 (BNL—50579, pp 257-277) **Optimizing kaon production.** Berley, D. (National Science Foundation, Washington, DC). Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

Kaon production data are examined with the view toward producing high quality beams in the future. Emphasis is placed upon the low momentum region, below 1 GeV/c, where the behavior of the kaon momentum spectrum is shown to be dominated by strongly momentum dependent kinematic factors. No complete experimental survey of production cross sections at different incident proton energies exists from a single apparatus. Information on relative production yields for different proton energies is important in the choice of parameters for an accelerator constructed primarily as a source of kaons. A summary is presented of existing kaon production facilities in the United States. These are all at proton accelerators. The possibility of using electron accelerators as kaon sources is examined. It is found that secondary beam fluxes can be contained at electron linacs, which are comparable to those obtained at proton synchrotrons. All kaon beam transport systems presently in use employ quadrupole and dipole magnet elements. A superconducting solenoid transport system has the potential advantage of much larger solid angle acceptance than the familiar quadrupole system. The possibility of mass separation by the differential energy loss method appears adaptable to the solenoid system.

40090 (BNL—50579, pp 280-284) **High current proton linear accelerators: possibilities for "kaon factories".** Knapp, E.A. (Los Alamos Scientific Lab., NM). Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

Proton linear accelerators are not usually considered for K-meson factor applications, being considered too expensive and space-consuming. Developments arising from the construction of the Los Alamos Meson Physics Facility (LAMPF) may make the proton linac competitive with other accelerator types for this application. At Los Alamos we have recently received notice that the National Cancer Institute (N.C.I.) will fund a program to develop prototype components for a high gradient, low duty factor proton linear accelerator suitable for pi-meson production for cancer therapy. Extensions of the technology developed on this program should make linear accelerators competitive with rapid cycling synchrotrons for kaon factory applications.

AUXILIARIES AND COMPONENTS

40091 (BNL—50579, pp 95-118) **Slow kaon beams at Argonne.** Colton, E.P. (Argonne National Lab., IL). Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

A report is given on two kaon beams which have operated at the ZGS, both from the same target location. Beam production and beam transport are discussed, and beam characteristics are tabulated. (PMA)

EXPERIMENTAL FACILITIES AND EQUIPMENT

40092 (BNL—50579, pp 383-390) **Feasibility of using a bent crystal spectrometer for precise kaonic x-ray measurements.** Lu, D.C. (Yale Univ., New Haven). Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

A brief discussion is given on the possibility of conducting experiments which involve very precise measurements of kaonic and hyperonic x-rays with a bent crystal spectrometer. Examples of such experiments are given to illustrate the typical issues of the feasibility and the significance of the bent crystal measurement. (PMA)

40093 (LA—6020) **Parametric studies of target/moderator configurations for the Weapons Neutron Research (WNR) facility.** Russell, G.J.; Seeger, P.A.; Fluharty, R.G. (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1977. Contract W-7405-ENG-36. 87p. P 05/MF A01.

Parametric studies, using continuous-energy Monte Carlo codes, were done to optimize the neutronics of the Weapons Neutron Research (WNR) target and three possible target/moderator configurations: slab target/slab moderators, cylindrical target/cylindrical moderator, and cylindrical target/double-wing moderators. The energy range was 0.5 eV to 800 MeV. A general figure-of-merit (FOM) approach was used. The WNR facility performance can be doubled or tripled by optimizing the target and target/moderator configurations; this approach is more efficient than increasing the Clinton P. Anderson Meson Physics Facility (LAMPF) accelerator power by an equivalent factor. A bare target should be used for neutron energies above approximately 100 keV. The FOM for the slab target/slab moderator configuration is the best by a factor of at least 2 to 3 below approximately 1 keV. The total neutron leakage from 0.5 eV to 100 keV through a 100- by 100-mm area centered at the peak leakage is largest for the slab moderator, exceeding that of the cylindrical moderator and double-wing moderator by factors of 1.7 and 3.4, respectively. The neutron leakage at 1 eV from one 300- by 150-mm surface of a slab moderator is 1.5 times larger than that from one 155- by 150-mm surface of a cylindrical moderator. When compared with the 1-eV leakage from two 100- by 150-mm surfaces of a double-wing moderator, that from the slab moderator is 3.4 times larger. 107 figures, 13 tables.

40094 (LA—6718-MS) **Control and data acquisition system for Beam Line C and HRS.** Naivar, F.J.; Rogers, W.L.; Simmonds, D.D.; Spencer, J.E.; Spencer, N.C.; Stark, C.F. (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1977. Contract W-7405-ENG-36. 44p. P 03/MF A01.

The High Resolution Spectrometer (HRS) at LAMPF is a multimillion dollar facility intended for the study of proton induced reactions and scattering with 100 to 800 MeV protons. It will be used by research scientists from universities and other national laboratories throughout the United States. The design resolution of $+-1.5:10^{-5}$ is better than any similar system ever attempted in this energy range. To obtain this quality as well as fully realize the research potential of the facility, a rather sophisticated computer control and data acquisition system is required. The facility, based on a general multiuser, multitask, multiprocessor system, is described.

40095 **Liquid lithium target as a high intensity, high energy neutron source.** Parkin, D.M.; Dudey, N.D. (to Energy Research and Development Administration). US Patent 3,993,910. 23 Nov 1976. Filed date 2 Dec 1975. 18p.

PAT-APPL-636,865.

The invention described provides a target jet for charged particles. In one embodiment the charged particles are high energy deuterons that bombard the target jet to produce high intensity, high energy neutrons. To this end, deuterons in a vacuum container bombard an endlessly circulating, free-falling, sheet-shaped, copiously flowing, liquid lithium jet that gushes by gravity from a rectangular cross-section vent on the inside of the container means to form a moving web in contact with the inside wall of the vacuum container. The neutrons are produced via break-up of the beam in the target by stripping, spallation and compound nuclear reactions in which the projectiles (deuterons) interact with the target (Li) to produce excited nuclei, which then "boil off" or evaporate a neutron.

STORAGE RINGS

40096 (BNL—22234) **Summary of ISABELLE cryogenic systems workshop.** Brown, D.P. (Brookhaven National Lab., Upton, N.Y. (USA)). May 1976. Contract EY-76-C-02-0016. 14p. P 02/MF A01.

Twenty-four people participated in the ISABELLE Cryogenic System Workshop which was held on June 2 and 3, 1976. The magnet cooling system for ISABELLE, as described in the new proposal, utilizes supercritical helium as the refrigerant instead of pool-boiling helium as in earlier proposals. This new and more cost-effective system was described in detail with discussion of the design parameters for the refrigerator itself, turbomachinery required and the refrigerant distribution system. The testing and prototype development program for ISABELLE cryogenic system components was also reviewed. A small cryogenic turbocompressor/expander system is now on order for testing with an ISABELLE half-cell (2 dipoles and 1 quadrupole).

40097 (BNL—50629) **Estimate of the effect of anomalous length of electron bunch on quantum lifetime.** Month, M. (Brookhaven National Lab., Upton, N.Y. (USA)). 13 Jan 1977. Contract EY-76-C-02-0016. 10p. P 02/MF A01.

Electron bunches are observed to have a length larger than that value determined by the balance between radiation damping and quantum fluctuations. The question then arises as to whether this bunch lengthening and its associated energy widening significantly affect the quantum lifetime. As a first step, an order of magnitude model is presented here. The conclusions are that the effect could be observable at SPEAR II. Furthermore, it appears that PEP and PETRA operating at high energy could have drastically reduced lifetimes for particles near the outside rim of the bunch. It is suggested that experiments might be performed at SPEAR II to test the proposition that bunch lengthening and a reduced quantum lifetime are correlated.

INSTRUMENTATION

RADIATION INSTRUMENTATION

REFER ALSO TO CITATION(S) 39324

GENERAL DETECTORS AND MONITORS

40098 (BNL—50453, pp VIII.3-VIII.15) **Fly's eye: a counting camera for thermal neutrons: some applications, problems, and prospects.** Davidson, J.B. (Oak Ridge National Lab., TN). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

An area detector for thermal neutrons based on image intensification techniques is described. Some capabilities and limitations of the detection system are discussed. Among the former are high spatial resolution, high instantaneous counting rate, electronic zoom, time-gating, and integration. The detector is limited in that the maximum counting rate for a resolution element is 60 regularly spaced counts per second. Also, the nonuniformity of response over the detector puts a limit on the useful size and necessitates point-by-point calibration. In addition, a higher efficiency for neutron detection would be desirable. Some typical applications of the system are crystal inspection, neutron magnetic diffraction topography, and searches for temperature-induced changes in diffraction patterns. The future application of solid-state television sensors and microchannel-plate intensifiers to improve the system is briefly mentioned.

40099 (BNL—50453, pp VIII.16-VIII.23) **Neutron television camera detector.** Arndt, U.W.; Gilmore, D.J. (Medical Research Council Lab. of Molecular Biology, Cambridge, Eng.). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

A neutron area detector system is being developed at the Institut Laue-Langevin which is based on a system for x-rays. The system has a large counting rate capability; this is extremely important where the total background count exceeds the total counts in the signals of interest. Its spatial resolution is of the order of one mm, while the screen size is 400 mm. The main limitation of the system is its limited counting efficiency, and this is directly attributable to the optical self-absorption of the neutron phosphor. All coherent noise in the system, i.e., all noise synchronized with the TV scans, has to be kept lower than the first bit threshold. However, this requirement can be relaxed when dealing with diffraction patterns, such as those from single crystals, for which a local background is subtracted from the pattern.

40100 (BNL—50453, pp VIII.24-VIII.42) **Development of large-area, position-sensitive neutron detectors.** Alberi, J.L. (Brookhaven National Lab., Upton, NY). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

Gas-discharge detection of neutron-induced charged-particle reactions is considered as a method for the detection of thermal neutrons. The paper reviews the development of a neutron-sensitive, position-sensitive detector based on a ten-atmosphere, ^{3}He-and-Ar-filled, multiwire proportional chamber with resistive wire readout. The design parameters of a larger detector are indicated, along with a new readout method. The physical effect of nonorthogonal neutron trajectories on resolution in these larger detectors is also discussed.

40101 (BNL—50453, pp VIII.43-VIII.50) **Linear position-sensitive counter system for protein crystallography.** Cain, J.E.; Norvell,

J.C.; Schoenborn, B.P. (Brookhaven National Lab., Upton, NY). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

The paper describes a position-sensitive counter system for collecting neutron diffraction data from protein crystals. Use of a linear position-sensitive detector permits faster data collection and the use of smaller crystals. Data are collected in a normal beam geometry with crystal rotation. This method allows measurement of numerous reflections simultaneously along a linear detector and, although it is not the most efficient method for a linear detector, it is compatible with a two-dimensional position-sensitive detector, which will be added in the future. In general, reflections from a protein are measured by having the most densely populated planes of the reciprocal lattice horizontal and parallel to the linear detector. Reflections of different scattering angle, 2theta, are collected by the detector as the crystal is rotated about a vertical axis. Upper reciprocal lattice layers may be surveyed by effectively changing the ν-angle by raising the detector on its arm. This system has an improved data-collection rate compared with the standard single-counter neutron diffractometer.

RADIATION DOSEMETERS

REFER ALSO TO CITATION(S) 40619

40102 Mixed field dosimetry with $CaSO_4$(Tm) and $CaSO_4$(Tm)—Li_2SO_4. Huang, C.Y. (Atomic Energy Council of Executive Yuan, Taipei, Taiwan); Beach, J.L. *Nucl. Sci. J. (Taiwan);* **13**: No. 2, 70-77(Jun 1976).

This paper describes a thermoluminescent dosimeter which is small, sensitive, and easily read, and which exhibits no change in sensitivity in the presence of high fluences of thermal neutrons. A physical mixture of 60 percent $CaSO_4$(Tm) and 40 percent Li_2SO_4 is used as the neutron sensitive component, and 100 percent $CaSO_4$(Tm) is used as the neutron insensitive gamma component. The use of nonluminescing Li_2SO_4 in combination with neutron insensitive $CaSO_4$(Tm) gives a two compartment neutron detector which does not suffer significant lattice damage to the TL material from thermal neutrons. $CaSO_4$(Tm) has the added advantage of fading less than 1 percent per month.

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

REFER ALSO TO CITATION(S) 40589

40103 (NP-tr—1972) **Application of Fourier transformation to smoothing, background extraction and unfolding of spectra in nuclear physics.** Valero, S. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Mar 1977. Translation of CEA-N—1723. 63p. Environmental Protection Agency, NERC-Library, Washington, DC.

Analytical study is made of the Fourier transform of discrete spectra like the ones encountered in nuclear physics experiments; their mathematical properties give the basis for practical procedures for background subtraction, smoothing data, or unfolding spectra. Small-size codes can be expected from this method. 33 figures.

HIGH ENERGY PHYSICS INSTRUMENTATION

REFER ALSO TO CITATION(S) 40092

RADIOMETRIC INSTRUMENTS

REFER ALSO TO CITATION(S) 39360, 40111

40104 (MLM—2413(OP)) **β-backscatter measurement of thin-gold coatings.** Blue, P.L. (Mound Lab., Miamisburg, Ohio (USA)). 1976. Contract EY-76-C-04-0053. 6p. (CONF-761210—4). P 02/MF A01.

From Weapons Agencies Nondestructive Testing Organization meeting; Livermore, California, United States of America (USA) (6 Dec 1976).

A beta-backscattering thickness gauge for measuring gold coatings in the 8,000 to 16,000 A thickness range on codeposited chromium and gold coatings on ceramic substrates is briefly described. (WHK)

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

40105 (AD-A—029365) **Nuclear survivability for army tactical equipment: an approach to defining the benefits. Study project report.** Christensen, M.H. (Defense Systems Management School, Fort Belvoir, Va. (USA)). May 1976. 41p. NTIS $4.00.

Nuclear survivability is and will continue to be a design requirement for many new Army tactical systems progressing through the new materiel development process. The purpose of this study is to suggest an approach to getting a handle on exactly what it is that nuclear survivability buys for the Army so that rational cost/benefit decisions can be made. A conceptual approach is proposed which includes defining the survivability alternatives, selecting or developing a nuclear scenario, exercising the scenario using good weapons effects and vulnerability data, comparing results using appropriate measures of effectiveness, evaluating the sensitivity of the results to assumptions, and applying the results in conjunction with cost and other factors. An example application of this approach to a benefit analysis of three fictitious survivability alternatives of the Army's FM field radios is demonstrated. The approach presented represents a beginning in cost/benefit field which has received little attention.

40106 (N—76-28479) **Prediction and measurement of radiation damage to CMOS devices on board spacecraft.** Cliff, R.A.; Danchenko, V.; Stassinopoulos, E.G.; Sing, M.; Brucker, G.J. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jul 1976. 42p. (NASA-TM-X—71166; X—700-76-155). NTIS $4.00.

Submitted for Publication.

The initial results obtained from the Complementary Metal Oxide Semiconductors Radiation Effects Measurement experiment are presented. Predictions of radiation damage to C-MOS devices are based on standard environment models and computational techniques. A comparison of the shifts in CMOS threshold potentials, that is, those measured in space to those obtained from the on the ground simulation experiment with Co 60, indicated that the measured space damage is greater than predicted by a factor of two for shields thicker than 100 mils (2.54 mm), but agrees well with predictions for the thinner shields.

40107 (N—76-28474) **Radiation design criteria handbook.** Stanley, A.G.; Martin, K.E.; Douglas, S. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 1 Aug 1976. Contract NAS7-100. 349p. (NASA-CR—148510; JPL-TM—33-763). NTIS $10.00.

Radiation design criteria for electronic parts applications in space environments are provided. The data were compiled from the Mariner/Jupiter Saturn 1977 electronic parts radiation test program. Radiation sensitive device types were exposed to radiation environments compatible with the MJS'77 requirements under suitable bias conditions. A total of 189 integrated circuits, transistors, and other semiconductor device types were tested.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 39075, 39539, 39543, 39547, 39563, 39567

40108 (SAND—76-0136) **Periodic timer PI-200.** Campbell, J.W.; Hermesmeyer, L.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). May 1976. Contract EY-76-C-04-0789. 9p. P 09/MF A01.

The Model PI-200 periodic timer utilizes a crystal-controlled oscillator to provide a very accurate time base for actuation of surveillance equipment. The two outputs of the timer can be triggered alternately or simultaneously, with intervals selectable in 10-minute increments up to 100 minutes.

40109 (Y—2070) **Applications of the dimensional-measuring laser interferometer in the Oak Ridge Y-12 Plant Gage Laboratory.** Burrus, B.M. (Oak Ridge Y-12 Plant, Tenn. (USA)). Mar 1977. Contract W-7405-ENG-26. 32p. P 03/MF A01.

The report gives a layman's explanation of the operating principles of the dimensional-measuring laser interferometer, and a description, including photographs and illustrations, of the use of a portable laser interferometer in calibrating dimensional standards and measuring equipment in the Oak Ridge Y-12 Plant Gage Laboratory.

40110 (Y—2074) **Automated atomic absorption spectrophotometer, utilizing a programmable desk calculator.** Futrell, T.L.; Morrow, R.W. (Oak Ridge Y-12 Plant, Tenn. (USA)). 28 Mar 1977. Contract W-7405-ENG-26. 17p. (CONF-750330—2). P 02/MF A01.

From 26. Pittsburgh conference on analytical chemistry and applied spectroscopy; Cleveland, Ohio, USA (3 Mar 1975).

A commercial, double-beam atomic absorption spectrophotometer has been interfaced with a sample changer and a Hewlett-Packard 9810A calculator to yield a completely automated analysis system. The interface electronics can be easily constructed and should be adaptable to any double-beam atomic absorption instrument. The calculator is easily programmed and can be used for general laboratory purposes when not operating the instrument. The

automated system has been shown to perform very satisfactorily when operated unattended to analyze a large number of samples. Performance statistics agree well with a manually operated instrument.

WELL LOGGING INSTRUMENTATION

REFER ALSO TO CITATION(S) 39187, 39195, 39206, 39262, 40496

40111 Accurate thermal neutron decay time measurements with the dual-spacing TDT: a laboratory study. Nelligan, W.B.; Antkiw, S. New York; American Institute of Mining, Metallurgical, and Petroleum Engineers (1976). 12p. (CONF-761008—97).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Laboratory measurements of decay time were made with both the far and near detectors of a TDT-K sonde in 17.1-percent-porosity and 30.4-percent-porosity sandstone formations for several formation-fluid salinities in the range from 0 to 247,000 ppM NaCl. A 7-in. casing cemented in a 10-in. borehole was used with and without a $2^{7}/_{8}$-in. tubing centered in a gravel pack. Complete decay curves were recorded, and examples of these are presented. Values of intrinsic decay time calculated from nuclear-thermal-neutron-capture cross sections are compared with decay times measured with the far detector using the Scale Factor gating system, as well as with decay times derived from least-squares fits to the far-detector-decay curves. The uncertainties in the calculated intrinsic decay times caused by the uncertainties in the values of the nuclear cross sections are discussed for the laboratory formations used in the measurements. The results show the effects of the source-detector spacing and formation and borehole conditions on the measured values of the decay time. The analyses and data presented can be used to estimate the uncertainties in formation evaluations that depend on measured values of the decay time.

40112 Logging services used for large diameter boreholes. Atkinson, A.; Pointer, R. New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers (1976). 8p. (CONF-761008—91).

From 51. annual meeting of the Society of Petroleum Engineers; New Orleans, Louisiana, United States of America (USA) (3 Oct 1976).

Logging of large-diameter boreholes for formation evaluation and as an aid to construction has become a routine procedure at the United States Energy Research and Development Administration (ERDA) Nevada Test Site. Many of these logging services are being used in commercial applications such as mine shaft construction. Log interpretation has been altered to account for conditions of 121-cm (48 in.) to 304-cm (120 in.) diameter boreholes, generally above the water table, and penetrating volcanic rocks. The methods are described and log examples and photographs of the borehole instruments are shown. Application of the data is discussed.

40113 Intrinsic germanium detector used in borehole sonde for uranium exploration. Senftle, F.E.; Moxham, R.M.; Tanner, A.B.; Boynton, G.R.; Philbin, P.W. (Geological Survey, Reston, Va. (USA)); Baicker, J.A. (Princeton Gamma-Tech., Inc., Princeton, New Jersey, U.S.A.). *Nucl. Instrum. Methods;* **138**: No. 2, 371-380(15 Oct 1976).

A borehole sonde (approximately 1.7 m long; 7.3 cm diameter) using a 200 mm^2 planar intrinsic germanium detector, mounted in a cryostat cooled by removable canisters of frozen propane, has been constructed and tested. The sonde is especially useful in measuring X- and low-energy gamma-ray spectra (40-400 keV). Laboratory tests in an artificial borehole facility indicate its potential for in-situ uranium analyses in boreholes irrespective of the state of equilibrium in the uranium series. Both natural gamma-ray and neutron-activation gamma-ray spectra have been measured with the sonde. Although the neutron-activation technique yields greater sensitivity, improvements being made in the resolution and efficiency of intrinsic germanium detectors suggest that it will soon be possible to use a similar sonde in the passive mode for measurement of uranium in a borehole down to about 0.1% with acceptable accuracy. Using a similar detector and neutron activation, the sonde can be used to measure uranium down to 0.01%.

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

40114 (LA—6711-MS) **Hazard classification test of mixed-load 30-mm GAU-8 ammunition by bonfire and cookoff and sympathetic detonation testing.** Elder, J.C.; Tillery, M.I.; Ettinger, H.J. (Los Alamos Scientific Lab., N.Mex. (USA)). Feb 1977. Contract W-7405-ENG-36;AFAL-PRJ-R-441. 14p. P 02/MF A01.

A hazard classification test of mixed-load (high explosive and armor-piercing) 30-mm GAU-8 ammunition was performed in October, 1976, for the U.S. Air Force Armament Laboratory (AFATL). Fragment pattern scoring following bonfire cookoff of 180 live rounds indicated 385 ft was the maximum distance any fragment was thrown by explosions of the ammunition. Small amounts of uranium aerosol dispersed by the bonfire were detected at three air samplers placed near the bonfire. In a separate test, sympathetic detonation of high explosive rounds in a container of mixed-load ammunition was tested by detonating a single round. No sympathetic detonation occurred.

40115 (LA—6739-MS) **Detonation in miniature.** Fickett, W. (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1977. Contract W-7405-ENG-36. 3p. P 02/MF A01.

A simple mathematical analog for reactive flow is proposed: a kinematic wave equation like the Burgers or Korteweg-deVries equation, which has the necessary properties for application to detonation. Also given is a tentative table of contents of a proposed short book covering much of reactive flow and detonation theory "in miniature," that is, with discussion of properties and solutions of this analog and its variants.

40116 Insensitive explosive composition of halogenated copolymer and triaminotrinitrobenzene. Benziger, T.M. (to Energy Research and Development Administration). US Patent 3,985,595. 12 Oct 1976. Filed date 29 Nov 1974. 6p.

PAT-APPL-528,380.

A highly insensitive and heat resistant plastic-bonded explosive containing 90 wt % triaminotrinitrobenzene and 10 wt % of a fully saturated copolymer of chlorotrifluoroethylene and vinylidene fluoride is readily manufactured by the slurry process.

40117 Tagging explosives with sulfur hexafluoride. Dietz, R.N.; Cate, E.A.; Vogel, W.; Dempsey, J.C. (to Energy Research and Development Administration). US Patent 3,991,680. 16 Nov 1976. Filed date 15 May 1975. 4p.

PAT-APPL-577,822.

A method and apparatus for tagging explosives with a source of SF_6 permitting the detection of their presence utilizing sensitive sniffing apparatus are described.

NUCLEAR

WEAPONRY

40118 (AD—884266) **Tactical operations system. Basic system description. Annex I. Nuclear strike effects. Volume 2. Final report.** (Bunker-Ramo Corp., Canoga Park, Calif. (USA)). Oct 1970. Contract DAAK02-68-C-0509. 396p. NTIS $10.75.

See also Annex J, AD—884261L.

40119 (AD-A—028424) **Direct-induced, high-explosive simulation technique improvement program tests (DIP IVA and DIP VA). Final report.** Simmons, K.B. (New Mexico Univ., Albuquerque (USA). Eric H. Wang Civil Engineering Research Facility). Mar 1976. Contract F29601-72-C-0024. 102p. NTIS $5.50.

Two Direct-Induced, High Explosive Simulation Technique (DIHEST) improvement project (DIP) tests are reported. These tests are part of the Air Force program to simulate nuclear weapons effects. Although some tentative conclusions are discussed, sufficient data and experimental procedures are included to allow independent evaluation of the results. DIP IVA was a single-point test using a 1000-lb explosive charge. The purpose of the test was to collect ground-motion data to determine if point-source data can be used to design DIHEST arrays in a particular soil environment. However, the results were inconclusive because of the poor quality of the ground-motion data. DIP VA was a large planar array using 36 tons of explosive to determine if geometrical size could be used to increase displacements while keeping peak velocities and accelerations low. The results seem to indicate that for the geometrical size, DIP VA was not loaded sufficiently heavy to produce the large displacements desired.

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

40120 (EPA—840-76-007) **United States directory of sources: United States International Environmental Referral Center.** (Environmental Protection Agency, Washington, D.C. (USA)). Nov 1976. 410p. Environmental Protection Agency, Washington, DC.

National focal point of the United Nations Environment Program International Referral System.

The United Nations Environment Program (UNEP) was created in 1972 to promote international cooperation in the environmental field; to keep under review the world environmental situation in order to assure that environmental problems of wide international significance receive appropriate consideration by governments; and to promote the acquisition, assessment, and exchange of environmental knowledge. In order to assist in carrying out these goals the International Referral System (UNEP/IRS) was created that is composed of a network of over 60 national and international Focal Points engaged in identifying and registering sources of environmental information. In March 1975 the U.S. Environmental Protection Agency was designated to serve as the U.S. National Focal Point and EPA formally opened its Center on October 6, 1975, at its Headquarters in Washington, D.C. The U.S. National Focal Point has been named the United States International Environmental Referral Center (USIERC). This directory includes 601 sources registered with the United States International Environmental Referral Center as of September 1, 1976, and includes Federal Agencies, State and Local Governments, Universities, Business, Industry, Societies and Associations, Laboratories, Information Centers, Consultants, Engineering Firms, and others.

BASIC STUDIES

REFER ALSO TO CITATION(S) 39455, 40208

40121 **Two roles of ecologists in defining and determining the acceptability of environmental impacts.** van Winkle, W.; Christensen, S.W.; Mattice, J.S. (Oak Ridge National Lab., TN). *Int. J. Environ. Stud.*; 9: 247-254(1976).

A framework is presented for defining the environmental impact of a project on an ecosystem. An 8-step decision tree is introduced which leads to operational definitions of unacceptable and acceptable impacts. Within this framework, two roles ecologists play in the field of environmental impact assessment are considered: to supply scientifically sound and objective predictions of the potential impact of a project on an ecosystem, and to reach conclusions, based on his own value system, concerning the acceptability of the predicted impact.

40122 **Conference on coastal meteorology.** Boston; American Meteorological Society (1976). 137p. (CONF-760918—).

From Conference on coastal meteorology; Virginia Beach, Virginia, United States of America (USA) (21 Sep 1976).

Twenty-two papers discuss meteorological processes and phenomena of coastal areas, with emphasis on the Eastern coast of North America. Abstracts of four papers have appeared previously in ERA. (CH)

40123 (UCRL-Trans—11221) **Rate of coagulation and condensation growth of aerosol particles.** Smirnov, V.I. Mar 1977. Translation of Trudy tsentral'noi aerologicheskoi observatorii, No. 92, Gidrometeoizdata, Moscow, 1969. 159p. P 08/MF A01.

The monograph deals with the kinetic theory of polydisperse systems, in particular, atmospheric aerosols. It discusses equations describing the evolution of aerosols. Particular emphasis is placed on the determination of coagulation coefficients of uncharged and charged aerosols acted upon by several factors simultaneously (Brownian motion, turbulence, fall of particles). Formulas giving the rate of quasi-steady condensation growth (evaporation) of stationary drops are refined. The determination of coagulation and condensation rates is based on a new method of solving the problem of diffusion to a sphere at an arbitrary Knudsen number (ratio of the mean free path to the radius of the particles). This method makes it possible to determine both the flux to the sphere and the concentration jump at its surface. The elaborated theory is used to refine the modern concepts of the role of coagulation processes in the formation and evolution of the size distribution of cloud drops and their electric charges. The monograph is addressed to scientists in the area of atmospheric physics and may also be useful to physicists, physical chemists, and representatives of other specialties interested in the behavior of disperse systems.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 39126, 39127, 39130, 39171, 39397, 39458, 39459, 39746, 39920, 39923, 39982, 40063, 40198, 40200, 40202, 40474

40124 (COO—2988-1) **Determination of sulfur speciation in industrial aerosols in an SO_2 rich environment.** Eatough, D.J. (Brigham Young Univ., Provo, Utah (USA). Thermochemical Inst.). Mar 1977. Contract EY-76-S-02-2988. 17p. Dep. NTIS $3.50.

The research being conducted under this contract is designed to identify concentrations of sulfite, sulfate, trace metals, and nitrite species in aerosols produced by smelting and fossil fuel industries, establish the conditions (metal content, fuel type, SO_2 levels, temperature, humidity) and mechanism(s) of sulfite formation and study the stability of the various sulfur species in the ambient atmosphere. Research completed to date has resulted in the development of techniques for the identification of SO_3 and SO_4 in effluents from a Cu smelter and from fossil fuel combustion.

40125 (LA—6738-PR) **Development of air-monitoring techniques using solid sorbents. LASL Project R-059, NIOSH-IA-77-12. Progress report, April 1—September 30, 1976.** Wood, G.O.; Anderson, R.G. (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1977. Contract W-7405-ENG-36. 26p. P 03/MF A01.

A sampling and analysis method for four hydrazine compounds in air has been completed. Final modifications of the sampling tube and analytical procedure were made and tested. Characteristics of the analytical procedure were studied to determine upper and lower limits of measurement and precision. The total sampling and analysis method was tested for precision by comparing results from pairs of samples taken and analyzed simultaneously. Tube samples of 1,1-dimethylhydrazine vapor analyzed by gas chromatography were compared to parallel bubbler samples analyzed by colorimetry. The results were statistically the same. The method developed for hydrazine compounds in air was written in the NIOSH format. Efforts have shifted to development of a method for aminoalcohols and polyamines. Five such compounds were satisfactorily analyzed by gas chromatography on a Carbowax 20M/KOH column. Attempts were made to improve the detectability of primary amines by forming derivatives. Desorption and storage studies with aminoalcohols demonstrated the deleterious effects of concentrated sulfuric acid coated on the silica gel. Eluents were found for efficiently eluting aminoalcohols from silica gel.

40126 (ORNL/CSD/TM—11) **Discrete event approach to pollutant transport and vegetation effects.** Murphy, B.D.; Dixon, K.R. (Oak Ridge National Lab., Tenn. (USA)). Mar 1977. Contract W-7405-ENG-26. 24p. (ESD—1016). P 03/MF A01.

Pollutant dispersion in the atmosphere together with plant carbon assimilation has been modeled for a growing season in the vicinity of a source of ^{14}C. The modeling studies point out the importance of accounting for correlations between the dispersion climatology and patterns of plant growth processes. There are significant differences between the detailed modeling of a typical season on an hour-by-hour basis and results using yearly averaged values of atmospheric concentration.

40127 (PB—259914) **Environmental impacts of advanced wastewater treatment at Ely, Minnesota.** Kibby, H.; Hernanez, D.J. (Environmental Protection Agency, Corvallis, Oreg. (USA). Corvallis Environmental Research Lab.). Aug 1976. 39p. (EPA—600/3-76/092). Q 03/MF A01.

The results presented in this report give an indication of the pollutants that would be generated and the resources consumed in operating a treatment facility similar to the one at Ely, Minnesota. The study analyzes not only the facility itself, but also those industries that supply products to the treatment plant. It was found that the total energy requirement of the advanced wastewater treatment plant was 50,000,000 Btu/million gallons of water treated. (GRA)

40128 (PB—260662) **Air quality data-1969 annual statistics. Final report.** (Environmental Protection Agency, Research Triangle Park, N.C. (USA). Monitoring and Data Analysis Div.). Oct 1976. 55p. (EPA—450/2-76/018). Q 04/MF A01.

This report is a statistical summary report on ambient air quality. The air quality statistics shown in this publication are produced directly from computer reports generated by EPA's online computer system. The data in this publication are being republished in the new revised format currently being used. Some of the data in this publication have been revised as a result of a recent effort to improve the quality of the past data. (GRA)

40129 (UCRL—52188) **Legislative history of the California Environmental Quality Act.** Wharton, J.C.; Lewis, M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Dec 1976. Contract W-7405-ENG-48. 36p. P 02/MF A01.

Following much general concern over pollution and its effects on the environment, and the enactment of the National Environmental Policy Act (NEPA), the State of California passed the Environmental Quality Act in 1970, which was the state equivalent of NEPA. This study examines the source of the act, the activity in the legislature prior to its passage, some of the cases which interpreted its applications, and the legislative responses to those cases. The evolution of the meaning of the California Environmental Quality Act (CEQA) started with Friends of Mammoth v. Board of Supervisors in which the court found that private individuals had standing to challenge decisions of governmental entities within the state. An impact report on a project's effect on the environment is required for

any entitlement given to a private person. The legislative amendments that incorporated the holding of Friends of Mammoth are discussed. The substantive and the procedural aspects of CEQA are critically examined with the conclusion that the legislature should include a clearer statement of the substantive rights contained in CEQA.

40130 Benzo(a)pyrene in settling dust in Zurich. Schaad, R.; Gilgen, A. *Atmos. Environ.;* **4**: 489-500(1970). (In German).

The water-insoluble fraction of settling dust sampled by Bergerhoff devices in different zones of Zurich, Switzerland, and in a rural area during the period of June 1965 through May 1966 was analyzed for benzo(a)pyrene by fluorescence spectrophotometry. The average benzo(a)pyrene contents in the dust were 13 micrograms/g in summer, and 20.6 micrograms/g in winter, against 6.1 micrograms/g and 9 micrograms/g for the corresponding periods in a rural area. The benzo(a)pyrene fallout was 369 micrograms/sq m/180 days in the summer period, and 369 micrograms/sq m/180 days for the entire town. The summer and winter averages determined for the rural area were 94.8 and 76.2 micrograms/sq m/180 days, respectively. In Zurich, the annual average benzo(a)pyrene fallout was 745.7 micrograms/sq m in zones with high traffic density, and 488.8 micrograms/sq m in zones with low traffic density. The effect of traffic prevails over those of domestic heating and industry-generated emissions.

40131 Environmental protection in Polish industrial centers. *Umwelthygiene;* **25**: No. 12, 277-278(1974). (In German).

Poland is appropriating increasingly more funds for combating environmental pollution in its industrial centers. The Krakow and Silesian industrial centers have an extension which is surpassed only by the Ruhr area in the Federal Republic of Germany. In Chorzow the annual dust emission limit of 350 tons/sq km is exceeded by 1200 tons/sq km. The solar ultraviolet radiation is here 40% lower and the mortality is higher than in the rest of the country. As preliminary measures, the green zones have been expanded and coniferous trees were replaced by more resistant deciduous trees. Every industrial enterprise is required to clean its waste gases to set standards. The country has developed its own version of electrostatic precipitators which achieve dust collection efficiencies of 90% and more. They are manufactured in Pszczyna. Also, desulfurization processes of coal are being developed. The wet absorption of sulfur dioxide has been introduced in sulfuric acid plants. Reductions of the dust emission by 20,000 tons per annum are planned.

40132 Bibliography of the determination of hydrogen sulfide, sulfur dioxide, and their mixtures. Chaigneau, M.; Santarromana, M. *Rev. Inst. Fr. Pet.;* **29**: No. 5, 697-713(1974). (In French).

Methods available for the separate and joint determination of hydrogen sulfide and sulfur dioxide are reviewed, and a related bibliography comprising 332 entries is presented. Hydrogen sulfide can be adsorbed from air by activated carbon, nickel, or potassium benzosulfonate for subsequent gas-chromatographic determination, or on salts of copper, silver, and lead for volumetric, gravimetric, or colorimetric determination. Turbidimetric, polarographic, potentiometric, coulometric and diffractometric determination is also possible. Sulfur dioxide can be determined by acidimetric, spectrophotometric, gas-chromatographic, emission spectrometric, flame-photometric, radiochemical, polarographic, amperometric, and coulometric methods.

40133 On-line chromatograph for the selective measurement of hydrocarbons within the framework of environmental protection. Ball, H.; Mueller, F. *Siemens-Z.;* **48**: No. 9, 622-625(Sep 1974). (In German).

An automatic chromatograph for the selective analysis of hydrocarbons in the air is described. The air to be analyzed is sampled in an adsorber column cooled to -30°C, after which the residual gases and air are expelled with nitrogen and the captured hydrocarbons are desorbed by heating. The desorbed hydrocarbons are chromatographically separated, analyzed, and recorded by the gas chromatograph. The chromatograph can be controlled by computer and is suitable for use in laboratories and in mobile testing units alike. The lowest measurement range is between zero and 10 ppb, while the lowest limit of detectability is 0.5 ppb.

40134 Determination of nitric oxides near internal combustion engines according to the modified Saltzman method. Prietsch, W. *Z. Gesamte Hyg. Ihre Grenzgeb.;* **21**: No. 4, 298-302(1975). (In German).

A comparison of measurements using infrared spectroscopy, chemiluminescence, phenoldisulfonic acid, and the Saltzman methods revealed that the modified Saltzman method gave reliable values in the concentration range of 300 to 4100 ppM, if a Saltzman factor of 0.72 was used. The Saltzman method has the added advantage of saving considerable time. It is based on the reaction of nitrogen dioxide in a solution containing acetic acid, sulfanilic acid and N-(1-naphthyl-)ethylene diaminedihydrochloride producing a red azo dye with an extinction maximum at 550 nm.

40135 Statistical prediction of air pollutant concentration. III. Ootaki, A.; Shiozawa, K.; Okamoto, S. *Taiki Osen Kenkyu;* **9**: No. 3, 567(1975). (In Japanese).

The prediction system for regional air pollution is discussed. The method provides the statistical simultaneous forecast in time-spatial axes by employing an estimation theory. The validity of the given system was examined by making a simulated prediction of sulfur dioxide concentration 1 hour ahead of time at 14 monitoring stations in the Chiba Prefecture. The correlation coefficient between the calculated concentration and the observed values in each station is almost 1. This system may be available for 24-hr prediction of air pollutant concentration if sufficient meteorological data is available.

40136 Aspects of gas analysis by absorption spectroscopy. Schinkmann, M. *Draegerheft;* **300**: 28-36(1975). (In German).

Following a review of the fundamentals of absorption spectroscopic gas analysis, the three main spectroscopic methods, dispersive, nondispersive, and laser spectroscopy are discussed. Analyzers operating according to the dispersive method require a dispersion medium (prism, diffraction screen, interference filter). Non-dispersive spectroscopy compares the spectrum of the gas to be examined with that of a reference gas of pre-determined concentration. Laser operation spectroscopy is characterized by high selectivity. Carbon dioxide (CO_2), water (H_2O), nitric oxide (NO), nitrogen dioxide (NO_2), formaldehyde (H_2CO), acetone ($CH_3)_2CO$, and acetaldehyde (CH_3)HCO can be determined with the CO laser, benzene (C_6H_6), ethylene (C_2H_4), hydrogen fluoride (H_2S) and ozone (O_3) with the CO_2 laser. Ammonia can be determined with either the CO, the CO_2, or N_2O laser, or by sulfur dioxide with the CO_2 or xenon laser.

40137 Evidence for fidelity of chromatin reconstitution. Stein, G.S.; Mans, R.J.; Gabbay, E.J.; Stein, J.L.; Adawadkar, P.D. (Univ. of Florida, Gainesville). *Biochemistry;* **14**: No. 9, 1859-1866(1975).

Several lines of evidence are presented which support the contention that chromatin may be dissociated, fractionated, and reconstituted without altering the compositional, structural, or transcriptional integrity of the genome. The similar compositions of native and reconstituted chromatins are suggested by the absence of significant differences in their protein/DNA ratios and in the polyacrylamide gel electrophoretic profiles of their histones and nonhistone chromosomal proteins. Criteria for fidelity of genome structure in reconstituted chromatin include binding of reporter molecules with specificity for the minor groove of DNA, binding of histones, number of sites available for addition of nucleotides, and circular dichroism spectra. When the transcriptional activities of native and reconstituted chromatins were compared under conditions where reinitiation is prohibited, significant changes were not observed. Taken together, the present results strongly suggest, but do not conclusively establish, fidelity of chromatin reconstitution.

40138 Contribution of the Electricite de France to air pollution control in the Paris region. Rameux, R.; Jolliot, C. *Rev. Gen. Therm.;* **14**: No. 157, 27-41(Jan 1975). (In French).

An acid pollution monitoring system installed in Paris and its suburbs around power plants is described. The network is composed of 20 Seres and five Biolafitte model AFG analyzers for continuous pH measurement. The sampling stations are connected to a central computer for data processing and alarm release. The alarm threshold is set at a sulfur dioxide concentration of 600 micrograms/cu m as an hourly mean. At wind speeds below 2 m/sec, the alarm is activated whenever three sampling stations in or around Paris measure concentrations over 600 mg/kg for more than 1 hr. At wind speeds over 2 m/sec, the alarm is released whenever sampling stations in the plume direction have recorded values over 600 micrograms/cu m for more than 1 hr. The alarm notifies the power plants that they are required to reduce their load or to switch over to low-sulfur fuel oil.

40139 Immission measurements of O_3 for determination of photochemical conversion in close to ground air layers. Birkle, M. *Staub-Reinhalt. Luft;* **35**: No. 2, 41-45(Feb 1975). (In German).

Selective ozone measurements with a chemiluminescence analyzer were taken in Mannheim and Karlsruhe, Federal Republic of Germany, intermittently from 1972 to 1974. In addition, the concentrations of nitric oxide, nitrogen dioxide, total sulfur compounds, dust, carbon monoxide, carbon dioxide, and total hydrocarbon compounds were measured along with the barometric pressure and temperature. The results of the O_3 measurements were classified by diurnal fluctuations. Three different groups of diurnal fluctuations could be distinguished, bad weather diurnal fluctuations which could be observed on rainy days with strong winds, good weather diurnal variations occurring on sunny days with no winds, and all combinations of bad weather and good weather diurnal variations. The possibilities of smog prediction and warning are discussed.

40140 Carbon dioxide and carbon monoxide. Yoshizawa, S. *Kuki Chowa Eisei Kogaku;* **49**: No. 3, 66(Mar 1975). (In Japanese).

Measurement methods for indoor carbon dioxide and carbon monoxide are reviewed. The CO_2 measurement is easy since CO_2 is found in high concentration; 300 to 3000 ppM. The methods for CO_2

are a detection tube method, barium hydroxide method, interferometry, and non-dispersive infrared absorption. The detection tube method uses a small tube packed with absorbent with alkaline solution, in which CO_2 reacts with water forming carbonic acid that is neutralized by the alkali and changes the color of the absorbent. The barium hydroxide method utilizes the neutralization of carbonic acid; however, the CO_2 is determined from the amount of unreacted barium hydroxide by titration. The non-dispersive IR method is suitable for a continuous CO_2 analysis and it does not suffer from interference by other compounds except water. The indoor CO level is much lower than the CO_2 level. Methods are colorimetry with a packed tube, non-dispersive IR absorption, and electrochemical techniques. The tube, packed with palladium sulfate and ammonium molybdate on silica gel, gives a color change depending on the amount of CO passed through the tube. The non-dispersive IR method is not as good for the CO_2 analysis; it requires a longer absorption tube; interferences by water and CO_2 are large. The electrochemical method utilizes the reaction of CO to CO_2 in an electrolytic solution, which accompanies the voltage change in the solution. There is no interference by water and CO_2, however a small interference by nitric oxide, nitrogen dioxide, and ethylene are involved.

40141 Oxidation of H_2S on active carbon catalyst. Sreeramamurthy, R.; Menon, P.G. *J. Catal.;* **37**: No. 2, 287-296(May 1975).

The air oxidation of hydrogen sulfide to sulfur on an activated charcoal catalyst was studied at temperatures between 65 to 100°C. The pattern of sulfur deposition on the catalyst was followed for changes in surface area, pore-size distribution, and reactivity by electron probe microanalysis. Sulfur was initially deposited in layers of over 20 sulfur atoms thick in the larger pores which accounted for about 70% of the catalytic activity. This was followed by a gradual filling of the micropores with a 4-atom thick layer of sulfur. The reaction was quantitative for removal of H_2S from air and for recovery of sulfur. At temperatures above 120°C, the molten sulfur flowed down the catalyst bed and was tapped off, with the catalyst remaining active for days or weeks. The system was also found useful for following the advancing maxima in temperature profiles and rate profiles of a rapidly fouling catalyst bed for an exothermic reaction.

40142 Calculation method of SO/sub x/ aggregate volume control. Moriguchi, M. *Taiki Osen Kenkyu;* **9**: No. 5, 749-767(May 1975). (In Japanese).

A method of calculating total pollution concentrations is described. Smoke sources data must be collected by season, by heating and nonheating periods, and by day and by night. Data on other sources, such as ships, which are not controlled by law must also be collected. Models of meteorological data must be prepared, as well as diffusion models. When the simulation results are compared with actual pollution concentration figures, judgment is based on three factors: the regression coefficient (within the range 0.8 to 1.2), the correlation (over 0.71 at least, if possible over 0.8), and the concentration pattern. A forecast must be made of future smoke sources, meteorological conditions, and pollution concentration. Since it is unfeasible to require smaller enterprises to install desulfurization equipment, the major part of pollution control becomes the responsibility of big enterprises.

40143 (PB—255130) Environmental program administrators. (Environmental Protection Agency, Washington, D.C. (USA). Office of Regional and Intergovernmental Operations). May 1975. 53p. NTIS $4.50.

This tabulation of Environmental Program Administrators listing state officials and their respective areas of responsibility has been assembled to facilitate and improve interstate cooperation and intergovernmental communications. The availability of this information is expected to result in more frequent contact among the various state agencies and expedite responses to environmental issues and problems. The information provided in this tabulation has been verified. (GRA)

40144 Minimal pollutant production in combustor by the Katz algorithm and by a numerical method. Barrere, M.; Borghi, R. *Aerotec.-Missili Spazio;* **54**: No. 3, 155-165(Jun 1975).

The optimization of a series of homogeneous chemical reactors with a schematic description of the whole combustor is presented. In the first part, optimization is made by a graphic method, explained simply for a set of three reactors. Gas composition, temperature evolution along the combustor, and residence time in each reactor are the three main parameters affecting nitric oxide production. In a second part, with a view to optimize on a larger number of parameters, a numerical method of conjugate gradients was used. An optimization technique which is both simple and realistic is described. When the reactors are mounted in a series, the minimum content of the combustor outlet is provided by an infinity of homogeneous reactors, a configuration corresponding to a tubular reactor.

40145 Sulphate aerosols. Brosset, C. (Swedish Water and Air Pollution Research Lab., Gothenburg,). *Am. Chem. Soc., Div. Environ. Chem., Prepr.;* **16**: No. 1, 19-21(1976).

From Conference of the Division of Environmental Chemistry, of the American Chemical Society; New York, New York, United States of America (USA) (4 Apr 1976).

See CONF-760447—P1.

Two types of transported particles found from 3 previous studies on aerosols in Sweden: one type particle is dark, large, acid and largely ammonium sulfate. Another type is small, colorless, and largely acid ammonium sulfate. It is believed that the black particles are formed through oxidation of SO_2, and the colorless through photochemical reactions. It can be seen from other studies that continental particles may contain appreciable concentrations of such metals that can catalyze the oxidation of SO_2, which led to attempts to quantify the process of oxidation of SO_2. The study introduces formula systems whereby a relationship can be derived between the most common concentration in a gas phase and a liquid phase in equilibrium with each other and with the solid phase assumed previously. The practical importance of these formula systems is being examined. Several tables and equations are included.

40146 Lead (Pb) concentrations associated with 1000 mb geostrophic back trajectories at Quillayute, Washington. Fox, T.D.; Ludwick, J.D. (Battelle Pacific Northwest Labs., Richland, WA). *Atmos. Environ.;* **10**: No. 10, 799-803(1976).

Daily averaged Pb concentrations in the air at Quillayute, Washington, are related by an objective method to 1000 mb geostrophic backward one-day air trajectories. Although the trajectories ignore topography, the results confirm the expectation that land areas are source regions for Pb. High Pb values in land-trajectory air indicate the influence of anthropogenic sources within the region of the air-monitoring station. Low oceanic trajectory Pb concentrations are indicative of levels to be expected in air over the ocean and away from major Pb sources.

40147 Frequency and diurnal variation of dust storms in the contiguous U.S.A. Orgill, M.M.; Sehmel, G.A. (Battelle Pacific Northwest Labs., Richland, WA). *Atmos. Environ.;* **10**: No. 10, 813-825(1976).

Studies of regional wind erosion and the translocation of suspended particles are important for accurate surveys of air pollution. This category of investigation has nationwide implications for planning and regulatory purposes. However, most regional studies of wind suspension (airborne dust) have centered around the Great Plains without much consideration given to other areas of the country. The purpose of this study is to quantitate the wind translocation problem throughout the contiguous United States by using visibility as an index. National Weather Service and military surface observations on dust were analyzed for annual, monthly and diurnal periods. Frequency of dusty periods were based on hourly weather observations from stations recording dust, blowing dust, and blowing sand when visibility was 7 miles or less. Mountainous, forested, and predominantly maritime regions are generally free from major dust storms. The highest dust frequency is in the Southern Great Plains. Secondary dust frequency maxima occur in the Western States, Northern Great Plains, southern coastal Pacific and inland valleys and the Southeast. Maximum dust frequency occurs in early and late spring months for most regions but some regions experience additional dust in summer or fall. Hourly observations show higher dust frequencies occur in the afternoon between 12.00 and 20.00 LST, or during the period of maximum thermal instability.

40148 Acid precipitation in Canada. Summers, P.W.; Whelpdale, D.M. (Environment Canada, Toronto). *Water, Air, Soil Pollut.;* **6**: No. 2/3/4, 447-455(1976).

The total annual emissions of sulfur oxides and nitrogen oxides in Canada are estimated to be 7.2×10^6t and 1.4×10^6t, respectively. These figures represent 5% and 2%, respectively, of the estimated worldwide anthropogenic emissions. Nearly two-thirds of the Canadian SO_2 emissions come from primary smelters located in low population areas. The remainder originate from natural gas processing, pulp mills, fuel combustion and transportation in the more heavily populated areas. Transportation is the major source of oxides of nitrogen. No co-ordinated precipitation sampling has been carried out on a national basis prior to the establishment of the World Meteorological Organization regional stations in 1974, but several local projects in problem areas have been conducted over the last 20 yr. These data are reviewed with respect to sulphate and nitrate content, and when available, the pH. The geographical distribution of acid rain in Canada is discussed in relation to main source areas of pollutants, prevailing meteorological conditions and precipitation type. Finally, the extent of current and potential problems associated with acid rain is discussed, and current and recommended future monitoring and research programs are outlined.

40149 Hydrogen ion input to the Hubbard Brook Experimental Forest, New Hampshire, during the last decade. Likens, G.E. (Cornell Univ., Ithaca, NY); Bormann, F.H.; Eaton, J.S.; Pierce, R.S.; Johnson, N.M. *Water, Air, Soil Pollut.;* **6**: No. 2/3/4, 435-445(1976).

Being downwind of eastern and midwestern industrial centers, the Hubbard Brook Experimental Forest offers a prime location to monitor long-term trends in atmospheric chemistry. Continuous measurements of precipitation chemistry during the last 10 yr provide a measure of recent changes in precipitation inputs of H ion. The weighted average pH of precipitation during 1964-65 to 1973-74 was 4.14, with a minimum annual value of 4.03 in 1970-71 and a maximum annual value of 4.21 in 1973-74. The sum of all cations except H ion decreased from 51 μeq l^{-1} in 1964-65 to 23 μeq l^{-1} in 1973-74 providing a significant drop in neutralizing capacity during this period. Based upon regression analysis, the input equivalents of H ion and nitrate increased by 1.4-fold and 2.3-fold respectively, from 1964-65 to 1973-74. Input of all other ions either decreased or showed no trend. Based upon a stoichiometric formation process in which a sea-salt, anionic component is substracted from the total anions in precipitation, SO^{2-}_4 contribution to acidity dropped from 83% to 66%, whereas NO_3^- increased from 15% to 30% during 1964-65 to 1973-74. The increased annual input of H ion at Hubbard Brook during the past 10 yr is highly correlated with the increased input of nitrate in precipitation.

40150 Hydrogen ion speciation in the acid precipitation of the northeastern United States. Galloway, J.N.; Likens, G.E.; Edgerton, E.S. (Cornell Univ., Ithaca, NY). *Water, Air, Soil Pollut.;* **6**: No. 2/3/4, 423-433(1976).

The acidity of precipitation in rural, forested areas of the northeastern United States is dominated by the strong mineral acids: H_2SO_4 and HNO_3. Weak acids have a negligible effect on the measured acidity (pH) of precipitation. These conclusions are based on the total acidity titrations and detailed analysis of organic and inorganic components in precipitation.

40151 Evidence for multiple hydrogen-ion donor systems in rain. Krupa, S.V.; Coscio, M.R. Jr.; Wood, F.A. (Univ. of Minnesota, St. Paul). *Water, Air, Soil Pollut.;* **6**: No. 2/3/4, 415-422(1976).

An integrated analytical system consisting of combined scanning electron microscopy and x-ray analysis, atomic absorption, colorimetry and coulometry was used to study rain water chemistry. The coulometry facilitated the determination in molarities of strong and non-volatile and volatile weak acids. The pH of individual rains in St. Paul-Minneapolis, Minnesota ranged from 4.0 to 5.65 during the summer of 1974. Samples of a given rain from different sites had different qualitative and quantitative bases for the measured pH. Increase in strong acid concentrations with a decrease in pH was not an exclusive phenomenon. Molarities of weak acids (volatile and/or non-volatile) also increased with an increase in the acidity. Studies conducted on Twin Cities rain samples indicated that the total salt content expressed from the electrical conductivity could not be accounted for by the total concentrations of individual metals quantified (Fe, Pb, Zn, Mn, Cu, Cr, Cd, Ca, Mg, Na, and K). In addition, no correlation could be shown between the contents of SO_4^-, NO_3^-, Cl_2^-, and PO_4^- and the observed changes in pH.

40152 Chemical composition of atmospheric precipitation from selected stations in Michigan. Richardson, C.J. (Univ. of Michigan, Ann Arbor); Merva, G.E. *Water, Air, Soil Pollut.;* **6**: No. 2/3/4, 385-393(1976).

The pH and amount of rainfall from over 60 selected stations throughout northern and lower Michigan was determined from September 1972 to December 1974. Precipitation pH was determined for each station by calibrated electrode meters. The seasonal weighted average and median pH from all stations in the study was 5.0 and 6.3, respectively. Daily readings from stations throughout Michigan indicate that pH is dependent on the amount of rainfall and that variations in it are often locally controlled. Collectively the pH values suggest carbonic acid control for most of the state. Annual median pH varied from a high of 8.45 at Dimondale, a station located 1.5 km from a concrete tile plant in central Michigan to 4.65 at Vassar, a small town located east of several industrial centers in the thumb region of the state. A comparison of annual nutrient loading for NO_3^-, SO_4/sup =/, Cl^-, PO_4/sup identical with/, Ca^{++}, Mg^{++}, Na^+, K^+, and pH of rain water from selected stations revealed that the eastern U.S. stations reporting pHs $<$ 4.02 have similar loadings for NO_3 but twice the SO_4 input found for rural areas of Michigan.

40153 Effect of a local source on the composition of precipitation in south-central Maine. Boyce, S.D.; Butcher, S.S. (Bowdoin Coll., Brunswick, ME). *Water, Air, Soil Pollut.;* **6**: No. 2/3/4, 375-384(1976).

Bulk precipitation samples were collected from ten sites in south-central Maine during the period 18 June to 30 September, 1974. Data from the chemical analyses of the precipitation were used to determine regional deposition patterns of the ionic constituents. Acidic pH values ranging from 3.8 to 5.0 are characteristic of the region, but relatively alkaline pH values of 5.5 to 7.0 were observed in the precipitation from one collection site. Systematic increases in sulphate and Na deposition in the samples from this site suggest a local source. The observations of the bulk precipitation analysis lead to a study of the chemical composition of precipitation near a kraft paper mill. Samples were collected during single precipitation events. The results indicate that this source can affect background levels of composition up to a distance of at least 20 km and that considerable care must be taken in the selection of sites for sampling background precipitation.

40154 Chemical composition of acid precipitation in central Texas. Cooper, H.B.H. Jr. (Univ. of Texas, Austin); Lopez, J.A.; Demo, J.M. *Water, Air, Soil Pollut.;* **6**: No. 2/3/4, 351-359(1976).

Studies were undertaken to determine factors affecting composition of acidic precipitation formation in the Austin area of Central Texas. The study was initiated to determine background levels of acid and alkalinity producing constituents in an area with elevated natural dust levels from nearby limestone rock formations. Results showed normal rainfall pH values of 6.5 to 6.6 in the area, with extreme variations from 5.8 to 7.3. Significant Ca levels of 1 to 4 mg l^{-1} were observed from probably natural origin which appeared to have a buffering effect on acidity. Significant sulfate and nitrate ion concentrations occurred during the early stages of rainfall where rainfall pH was dependent on calcium-sulfate ratio.

40155 Measurement of acid precipitation in Norway. Semb, A. (Norwegian Inst. for Air Research, Kjeller). *Water, Air, Soil Pollut.;* **6**: No. 2/3/4, 231-240(1976).

Since January 1972, chemical analysis of daily precipitation samples from about 20 background stations in Norway has been carried out on a routine basis. Air monitoring is carried out at six stations. The chemical analysis program is: sulfate, pH and acidity in precipitation, sulfates and SO_2 in air. In addition, more detailed chemical analysis of aerosol and precipitation has been carried out at selected stations. Some results for the measurement period 1972 to 1974 are presented. Comparison of air and precipitation concentrations of S compounds show that the precipitatin scavenging efficiency is very high under the conditions in southern Norway.

40156 Calibration of collection procedures for determination of precipitation chemistry. Galloway, J.N.; Likens, G.E. (Cornell Univ. Ithaca NY). *Water, Air, Soil Pollut.;* **6**: No. 2/3/4, 241-258(1976).

Precipitation is currently collected by several methods, including several different designs of collection apparatus. We are investigating these differing methods and designs to determine which gives the most representative sample of precipitation for the analysis of some 25 chemical parameters. The exerimental site, located in Ithaca, New York, has 22 collectors of 10 different designs. The designs include bulk (wet and dry deposition collected together), wet only (only rain and snow) and wet/dry (collects wet and dry deposition separately). In every sampling period, which varies from 1 day to 1 mo, depending on the time variable being tested, the following chemical parameters are determined: conductivity, pH, Ca, Mg, Na, K, NH_4, N/sub total/, SiO_4, PO_4, P/sub total/, Cl, SO_4, DOC, Zn, Cu, Mn, Fe, Al, Ni, Cd, Pb, Ag, DDT, DDE, Dieldrin and PCB's. The results of the investigation lead us to conclude that: (1) Precipitation samples must exclude dry deposition if accurate information on the chemical content of precipitation is required. (2) Substantial contamination results when glass and plastic collectors are used to sample precipitation for inorganic and organic components, respectively. (3) The inorganic components of precipitation samples of low pH (3.5 to 4.5), with the exception of PO_4 and Cl, exhibited no significant change in concentration when stored at 4°C for a period of 8 mo. We believe this is due to the stabilizing influence of a large concentration of H ions. (4) If quantitative information on the chemcal composition is required, precipitation samples should be collected at no longer than weekly intervals if immediate collection is not possible.

40157 Acidic precipitation at a site within the northeastern conurbation. Jacobson, J.S.; Heller, L.I.; Van Leuken, P. (Boyce Thompson Inst. for Plant Research, Yonkers, NY). *Water, Air, Soil Pollut.;* **6**: No. 2/3/4, 339-349(1976).

Rain and snow were collected in plastic beakers either manually or with a Wong sampler during 58 precipitation events in 1974 at Yonkers, New York, approximately 24 km north of the center of New York City. Determinations were made of total dissolved ionic species, free H ions, total H ions, sulfate, nitrate, chloride, and fluoride. Conductivity measurements ranged from 6.8 to 162 μmhos, pH from 3.4 to 4.9, total acidity from 36 to 557 μeq l^{-1} sulfate from less than 1 to 20 mg l^{-1}, nitrate from less than 1 to 14 mg l^{-1}, and chloride from less than 1 to 7 mg l^{-1}. All fluoride concentrations were less than 0.1 mg l^{-1}. The results indicate that precipitation at this suburban location adjacent to New York City is consistently acidic and contains concentrations of sulfate, nitrate, and chloride which are similar to values found for other locations in the northeastern United States. Positive correlations were found between nitrate and sulfate concentrations and acidity suggesting that the atmospheric contaminants, SO_2 and NO_2, are causally-related to the occurrence of acidic precipitation. Further research will be necessary to clarify the relative influence of natural and man-made sources of N and S compounds and the contributions of gaseous and particulate

contaminants in the atmosphere to the acidity of precipitation at this location.

40158 Transport of pollutants considered from the point of view of a short and medium-range material balance. Benarie, M. (Inst. National de Recherche Chimiqe Appliquee, Vert-le-Petit, France). *Water, Air, Soil Pollut.;* 6: No. 2/3/4, 329-338(1976).

Episodical long range transport is the quasi-instantaneous peak event. It does not express the total dosage of pollutant carried over from the source area to some distant place. The purpose of the paper is to obtain an average material balance of a pollutant leaving a given area. Available information from the OECD "Long Range Transport of Air Pollutants" is being used for this purpose. The IRCHA is one of the laboratories participating in this project. Our main sampling station is 37 km from the center of the Paris district. This position allows us to compute, based on emission data from the area and air pollution survey records, the amount of pollutant (total S) leaving the region. We worked out this specific example because we had the first-hand, verified data. Out of a total emssion of about 300 kT SO_2 yr^{-1} (1972 figure), over 50% may be accounted for as remaining inside the 37 km-radius circle. Gaseous and p rticulate dry deposition mechanisms are considered mainly responsible for this fact. Less than half of the total S emission seems to be transported beyond the 37 km radius limit. The exact aspect of the deposition function within the national territory is currently being researched.

40159 Method of measuring airborne acidity: its application for the determining of acid content on long-distance transported particles and in drainage water from spruces. Brosset, C. (Swedish Water and Air Pollution Research Lab., Gothenburg). *Water, Air, Soil Pollut.;* 6: No. 2/3/4, 259-275(1976).

The acid properties of particles have been investigated by means of measuring the content of mainly strong acid in leaching solutions of particle samples and in drain water from trees. The measurements are based on Gran's plot and on a study of its curvature. Results indicate that it is likely that particles containing more or less acid ammonium sulphate can cause undesirable effects, e.g., when being inhaled. They may be of secondary importance as regards the acidification of land and lakes caused by wet deposition. On the other hand it seems as if dry deposition of particles on coniferous trees with subsequent secondary reactions and wash out can result in large depositions of acid on the ground level beneath the trees.

40160 Mechanism for hydrochloric acid production in clouds. Yue, G.K. (State Univ. of New York, Albany); Mohnen, V.A.; Kiang, C.S. *Water, Air, Soil Pollut.;* 6: No. 2/3/4, 277-294(1976).

A theoretical model describing the general interaction between atmospheric trace gases, such as SO_2, NH_3, CO_2 and O_2, chemicl reactant gaseous product H_2SO_4 and hydrometeors containing NaCl is proposed to study a possble mechanism for HCl production in non-precipitating clouds and the determination of the pH value of cloud droplets. Four different cloud droplet distributions have been used to estimate the upper limit of the amount of gaseous HCl released into the atmosphere resulting from the evaporation of cloud droplets. It is shown that the acid production and the amount of HCl released depend on the following factors: (a) the temperature of the cloud; (b) the oxidation rates; (c) the ambient concentration of SO_2, NH_3, and H_2SO_4; (d) the life cycle of the cloud; and (e) the liquid content of the cloud. This proposed chemical model also predicts a pH value spectrum depending on the cloud droplet distribution. Field measurements for the dependence of pH value on particle size and spatial distribution of gaseous HCl are recommended.

40161 Sulfur budget for sour gas plants. Rowe, R.D. (Univ. of Calgary, Can.). *Water, Air, Soil Pollut.;* 6: No. 2/3/4, 321-327(1976).

The principal aim of this project is to produce a mass balance for the SO_2 that is emitted into the atmosphere from sour gas plants in various localities in Alberta. Partial S budgets for two plants at dissimilar locations are shown to exhibit major differences. The rise and dispersion of sour gas plant plumes have been investigated in detail. In order to investigate the chemical transformation of SO_2 within these plumes, the use of a conserved tracer that can be detected by neutron activation is discussed.

40162 Organization of long range transport of air pollution monitoring in Europe. Ottar, B. (Norwegian Inst. for Air Research, Lillestroem). *Water, Air, Soil Pollut.;* 6: No. 2/3/4, 219-229(1976).

Atmospheric dispersion models are used to describe emission, dispersion and deposition of SO_2 and sulfate with particular emphasis on the acidification of the precipitation. An emission field has been constructed for Europe, and data from the European weather forecasting system are used for the dispersion calculations. Calculated concentrations and deposition are compared with data from about 70 ground stations and measurements from aircraft. Results show that the main cause for acidification of precipitation is the increasing use of fossil fuels. Large amounts of H_2SO_4 can be transported over distances up to a few thousand kilometers. In southern Scandinavia where the soil is highly acid (podsol), this has caused severe damage to life in rivers and lakes, and it is feared that in the future, there will be serious damage to forestry. In the Alps, where the soil has a high carbonate content, such effects are not expected. The long range transport of air pollutants has also been shown to increase the corrosion of materials. Work is now in progress to establish a more permanent system for the monitoring of air pollutants in Europe. The first plans for such a system were presented at the meeting in Oslo in December 1974, where countries from both Eastern and Western Europe participated. The work is supported by the Economic Commission for Europe, UN, in cooperation with other international organizations such as the World Meteorological Organization and the GEMS program of the United Nations Environment Program. Studies have also been taken up in several countries concerning the effects of the long range transport of air pollutants. In the future monitoring system, a coordination of these efforts is envisaged.

40163 Long range transport of air pollutants in Europe and acid precipitation in Norway. Nordoe, J. (Norwegian Inst. for Air Research, Kjeller). *Water, Air, Soil Pollut.;* 6: No. 2/3/4, 199-217(1976).

Observations show that pollutants from large emission sources may cause significant air concentrations 500 to 1000 mi away. Very acid precipitation occurs in such periods. The scavenging is often intensified by the topography. Case studies will be presented with special emphasis on acid precipitation in Scandinavia. Large scale dispersion models have been developed recently in order to estimate the long range transport of air pollutants. The models take into account chemical transformations as well as deposition of pollutants. The calculations will be compared with observations from airplanes and surface stations. A simple model has been integrated over a long period of time in order to derive the best value for the decay rate of SO_2. This best value is based on a day-by-day comparison with surface observations.

40164 Modeling atmospheric effects: an assessment of the problems. Fox, D.G. (Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO). *Water, Air, Soil Pollut.;* 6: No. 2/3/4, 173-198(1976).

The ability to simulate atmospheric processes that affect the life cycle of pollution is reviewed. The transport process is considered on three scales: (a) the near-source or single-plume disersion problem, (b) the multiple-source dispersion problem, and (c) the long-range transport. Modeling the first of these is shown to be well within the capability of generally available techniques, although determining the input parameters is often difficult. The second scale has been well studied within the context of urban diffusion and is a very productive area of current research. Finally, long range transport is treated mainly as a meteorological problem. The state of the art in modeling the various meteorological processes is reviewed. Removal of pollutants is discussed in the form of both dry deposition and precipitation scavenging. It is suggested that dry removal is especially effective in forested areas, and that the forests may enhance accumulation of pollutants. An approximate transport model is developed which is used to calculate the ambient concentration of SO_2 throughout the United States. Associated calculations include dry deposition and the ratio of dry to wet removal for each State of the contiguous United States.

40165 Environmental influences on the accumulation of lead, cadmium, mercury, antimony, arsenic, selenium, bromine, and tin in unicellular algae cultivated in Thailand and in Germany. Payer, H.D.; Runkel, K.H.; Schramel, P.; Stengel, E.; Bhumiratana, A.; Soeder, C.J. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Munich). *Chemosphere;* 5: No. 6, 413-418(1976).

The data presented in this paper concern the role of atmospheric dust immissions, rainfall, water quality, and fertilizers in the contamination of agricultural products by heavy metals. The amount of contaminants contributed by the individual pollution sources depends upon geographic factors and upon the type of fertilizers. In order to investigate such correlations, edible microalgae, suspended in liquid media and produced in outdoor cultures under natural climatic conditions were used as a model crop.

40166 Statistical aspects of the washout of polydisperse aerosols. Dana, M.T.; Hales, J.M. (Battelle Pacific Northwest Labs., Richland, WA). Contract AT(45-1)-1830. *Atmos. Environ.;* 10: 45-50(1976).

When considering the washout properties of polydisperse aerosols, one must specify whether the washout is in terms of number of aerosol particles, or in terms of length, area, or mass of aerosol. This follows from the fact that the effective washout coefficient is a function of the particle size distribution of the aerosol being removed. Sample calculations, using collection efficiencies covering particle radii in the range 0.001 less than a less than 10 μm and lognormal raindrop and particle size spectra show that the washout coefficient for a polydisperse aerosol is generally larger than it would be for a monodisperse aerosol of radius equal to some typically used distribution parameter. Thus, it is difficult, if not

practically impossible, to deduce generalized washout properties of aerosols from experimental measurements involving polydisperse aerosols.

40167 Air mass movements determined by real-time frontal chromatography of sulphur hexafluoride. Dietz, R.N.; Cote, E.A.; Goodrich, R.W. (Brookhaven National Lab., Upton, N.Y. (USA)). pp 277-297 of In Measurement, detection and control of environmental pollutants. Vienna; IAEA (1976).

From International symposium on the development of nuclear-based techniques for the measurement, detection and control of environmental pollutants; Vienna, Austria (15 Mar 1976).

Using a molecular sieve concentration trap and previously developed laboratory electron capture chromatographic procedures, sulphur hexafluoride was determined from 40 cm^3 samples at levels as low as $0.03x10^{-12}cm^3/cm^3$ - more than an order of magnitude below the present tropospheric SF_6 concentration of (0.3 to 0.5)$x10^{-12}cm^3/cm^3$. Air samples were satisfactorily obtained for 5 to 30 min using one-litre evacuated steel bottles equipped with critical orifices and for 5 to 10 h using inert pumps connected to 45-litre Saran (plastic) bags. With the concentration procedure, one analysis was performed every 10 min. The method was also applicable to other trace gas determinations such as ambient N_2O(approximately 0.27 ppm) using helium ionization chromatography. Application to power plant plume chemistry studies by simultaneous determination of SO_2, sulphate and added SF_6 showed that the measured decrease of pollutant concentration was primarily attributable to dilution. By continuously passing sampled air through specially treated molecular sieve columns up to 16 ft long, sulphur hexafluoride has been measured with real-time response for as long as 3.5 min between backflush periods. The completely portable instruments have been used in a number of field studies throughout the USA for the quantitative detection of added SF_6. With a limit of detection of about $0.2x10^{-12}cm^3/cm^3$, crosswind plume profiles were obtained and air masses were monitored at distances of 100 km during unstable meteorological conditions.

40168 PVC sample line interference with daily volumetric sulfur dioxide measurements. Crittenden, P.D.; Read, D.J. (Univ. of Sheffield, Eng.). *Atmos. Environ.;* **10**: No. 10, 897-898(1976).

In an investigation into the effect of ambient levels of air pollution on plant growth, volumetric samplers were employed to record daily mean concentrations of SO_2 and smoke in a glasshouse. Air samples were taken through uncovered PVC tubing. Acidity equivalent to sulphur dioxide concentrations of up to 50 $\mu g\ m^{-3}$ recorded in charcoal filtered air with a volumetric instrument and attributed to acid release from the PVC sample air line. The interference was correlated with temperature and reduced by covering the PVC tubing with a reflector. Estimates of sulphur dioxide concentrations in polluted air were corrected for this interference by subtraction of values recorded in filtered air. (FMM)

40169 Preliminary investigations of the pyrolysis products of insoluble polymer-like components of atmospheric particulates. Kunen, S.M.; Burke, M.F.; Bandurskii, E.L.; Nagy, B. (Univ. of Arizona, Tucson). *Atmos. Environ.;* **10**: No. 10, 913-916(1976).

Many studies have been done on the solvent soluble organic molecules extracted from the atmosphere but only recently have investigations been conducted on the insoluble or polymer-like carbonaceous portion of particulate matter. This study uses high vacuum pyrolysis, gas chromatography and mass spectrometry to break down the polymeric material into identifiable components. Pyrolysis products of various particulate samples are listed. It is suggested that this method will prove to be a powerful technique for defining particulates.

40170 Continuous and immediate method for the detection of SF_6 and other tracer gases by electron capture in atmospheric diffusion experiments. Thomsen, E.L. (Aerosol Lab., Risoe, Denmark); Lovelock, J.E. *Atmos. Environ.;* **10**: No. 10, 917-920(1976).

In many atmospheric diffusion experiments using tracer gases continuous tracer recording is of decisive importance. The main obstacle to continuous electron capture detection of tracer gases in the atmosphere is presented by the oxygen, which is an electron capturer. A method for removing this difficulty is described. Its practical use in an airborne atmospheric plume diffusion experiment is demonstrated.

40171 (PB—256091) Measurements to evaluate the benchmark properties of atmospheric aerosols. Technical report. Mendonca, B.G. (National Oceanic and Atmospheric Administration, Boulder, Colo. (USA). Air Resources Lab.). Jan 1976. 34p. (NOAA-TR-ERL—355; ARL—3). NTIS $4.00.

An experimental program was designed to monitor and analyze atmospheric aerosols. Observations from two Fort Collins sites indicate that the urban signature in aerosol concentrations, size distributions, hygroscopicity, and organic content is evident to 5.0 km from the center of the city. The surface sampling in this study showed the mass median diameters of the aerosol measured to be in the 2.5 x 0.00025 cm range. The submicron aerosols, however, were the more hygroscopic, the more active cloud condensation nuclei, and were slightly more organic in content. Evaluation of the instruments and techniques used describes the shortcomings of the measurement system, as well as the benefits of a composite measurement array for benchmark monitoring of atmospheric aerosols. (GRA)

40172 (PB—255698) Method for the determination of total mercury in ambient air. Final report. Hartley, A.M. (Illinois Inst. for Environmental Quality, Chicago (USA)). Feb 1976. 74p. (IIEQ—76-04). NTIS $4.50.

A method is described for the collection and measurement of total mercury in ambient air over a concentration range of 0.2 ng/cu m to 2.5 Hg/cu m. The collection system utilizes a Pyrolyzer to convert mercury compounds to elemental mercury which is then collected on gold-coated glass beads in a collection tube. Collected mercury is released for measurement by heating the collection tubes to 650 C in a gas stream which transports the vapor to the absorption cell of an atomic absorption spectrophotometer. Pyrolysis studies indicate that mercuric chloride, methylmercuric chloride, diphenylmercury are recovered with an efficiency of at least 95%. (GRA)

40173 (PB—257237) Reading references: I.P.E.A.I.D. international program in the environmental aspects of industrial development. Volume 1. Environmental planning, including master table of contents. Report for 1975—1976. McJunkin, F.E. (North Carolina Univ., Chapel Hill (USA). Dept. of Environmental Sciences and Engineering). Feb 1976. Contract AID/csd-3680. 352p. NTIS $10.50.

During March and April of 1975 the Department of Environmental Sciences and Engineering of the University of North Carolina conducted the second, on-campus session of its International Program in Environmental Aspects of Industrial Development (IPEAID). IPEAID provides an overview of available pollution control alternatives and technologies at a level of detail appropriate for individuals concerned with industrialization in general. To supplement the classroom lectures, seminars, and field trips; to reinforce the learning experience and help overcome language barriers; and to provide a basic reference library for permanent retention by the participants, IPEAID assembled an extensive collection of reading references. These are, in part, collected in five volumes. Volume 1 deals with environment planning. Portions of this document are not fully legible. (GRA)

40174 (PB—257240) Reading references: I.P.E.A.I.D. international program in the environmental aspects of industrial development. Volume 4. Industrial pollution. Report for 1975—1976. McJunkin, F.E. (North Carolina Univ., Chapel Hill (USA). Dept. of Environmental Sciences and Engineering). Feb 1976. Contract AID/csd-3680. 266p. NTIS $9.00.

Part of a five-volume report on environmental factors involved in industrial development, Volume 4 deals with such phases as toxicology, plant location, ionizing radiation, plating and metal finishing, employee considerations and the work environment, and ecology. Discussions are made of waste management in particular industries, including sugar, livestock, paper, metal finishing, and pickles. Principles and treatments are documented. Portions of this document are not fully legible. (GRA)

40175 (PB—257529) Continued research in mesoscale air pollution simulation modeling. Volume IV. Examination of the feasibility of modeling photochemical aerosol dynamics. Final report, Jun 1974—Jun 1975. Jerskey, T.N.; Seinfeld, J.H. (Systems Applications, Inc., San Rafael, Calif. (USA)). May 1976. Contract EPA-68-02-1237. 167p. (SAI/EF—75-26). NTIS $6.75.

A mathematical model of the dynamics of photochemical aerosols should include emissions of primary particulates and gaseous precursors of secondary aerosols, homogeneous nucleation, heterogeneous condensation, heterogeneous chemical reaction, coagulation, advection, diffusion, settling, and deposition on surfaces. This report discusses the theory of each of these processes and assesses the relative importance of each in shaping the volume distribution of photochemical aerosols. The authors conclude that in Los Angeles photochemical smog heterogeneous condensation is the principal mechanism for changes of the volume distribution in the accumulation size range, though homogeneous nucleation can be important under certain conditions for forming very small particles (less than 100 A diameter). Coagulation must be considered in reshaping the size distribution of emissions and in reducing the number of particles formed by homogeneous nucleation. An in-depth assessment is also presented of the pathways for the formation of aerosol material from the gas phase via homogeneous and heterogeneous chemistry. Finally, the equations governing the evolution of the photochemical aerosol are derived and simplified on the basis of order-of-magnitude calculations of the individual terms, and various equations for different properties of the aerosol are derived and discussed. (GRA)

40176 (PB—255886) Airborne LIDAR RAPS studies, February 1974. Environmental monitoring series. Eckert, J.A.; McElroy, J.L.;

Bundy, D.H.; Guagliardo, J.L.; Melfi, S.H. (Environmental Protection Agency, Las Vegas, Nev. (USA). Environmental Monitoring and Support Lab.). Jun 1976. 24p. (EPA—600/4-76/028). NTIS $3.50.

During February 1974, an airborne downlooking LIDAR system was flown in support of the Regional Air Pollution Study being conducted by the U.S. Environmental Protection Agency (EPA) in St. Louis, Missouri. The LIDAR system was used primarily to measure mixing layer height over the metropolitan area during the morning and evening transition periods. The flight plan consisted of south to north and west to east traverses with horizontal data resolution of 1.5 kilometers and a vertical resolution of 30 meters. Final data are presented in computer-generated, iso-scattering curves plotted for altitude versus ground-distance along the particular traverse. (GRA)

40177 (PB—256397) **Mechanism of photochemically initiated oxidations. Final report, Jan 1973—Dec 1975.** Calvert, J.G. (Ohio State Univ., Columbus (USA). Dept. of Chemistry). Jun 1976. 200p. NTIS $7.50.

Several significant new observations have been made relative to chemical reactions that occur in sunlight-irradiated NOx/hydrocarbon/aldehyde/CO/SO2 polluted atmospheres. Many of the primary reactions that are needed to quantitatively evaluate the photooxidation mechanisms of SO2 in the atmosphere were measured. Rate constants for the reactions of the excited SO2(triplet B1) state of SO2 with various atmospheric gases, alkanes, alkenes, NO, CO, etc., were determined. In view of these results, the rate of SO2 photooxidation in the atmosphere is estimated, and the possible role of excited- SO2/alkene interactions that generate aerosols is evaluated. Rate constants for the homogeneous reaction of SO2 with O3, NO3, and N2O5 were also estimated. All of these reactions are relatively slow for conditions that usually exist in polluted atmospheres. The unusual reaction of SO3 with NO2 was observed, although its importance in the atmosphere cannot be evaluated accurately from the existing data. An evaluation was made of the photochemical smog mechanisms using a computer to simulate the rates of change in various polluted atmospheres. Several important features of special interest in developing control strategies were observed. (GRA)

40178 (N—76-26718) **A four-channel portable solar radiometer for measuring particulate and/or aerosol opacity and concentration of NO_2 and SO_2 stack plumes.** Exton, R.J.; Gregory, R.W. (National Aeronautics and Space Administration, Langley Station, Va. (USA). Langley Research Center). Jun 1976. 17p. (NASA-TN-D—8182; L—10608). NTIS $3.50.

Solar absorption radiometry has been investigated as a method of measuring stackplume effluents. A simple and inexpensive instrument was constructed for observing the sun at four wavelengths: 800, 600, 400, and 310 nm. Higher wavelength channels measured the effect of the particulates and NO2, and an ultraviolet channel measured the contribution of SO2 to the attenuation. Stackplume measurements of opacity and concentration of NO2 and SO2 were in basic agreement with in-stack measurements. The major limitation on the use of the radiometer is the requirement for an accessible viewing position which allows the sun-plume-observer relationship to be attained. It was concluded that the solar radiometer offers an inexpensive method for monitoring plume effluents when the viewing position is not restricted. (Author) (GRA)

40179 (N—76-26984) **Infrared band absorptance correlations and applications to nongray radiation. Progress report, Mar—Jun 1976.** Tiwari, S.N.; Manian, S.V.S. (Old Dominion Univ., Norfolk, Va. (USA). School of Engineering). Jun 1976. 55p. (NASA-CR—148210). NTIS $4.50.

Various mathematical models for infrared radiation absorption spectra for atmospheric gases are reviewed, and continuous correlations for the total absorptance of a wide band are presented. Different band absorptance correlations were employed in two physically realistic problems (radiative transfer in gases with internal heat source, and heat transfer in laminar flow of absorbing-emitting gases between parallel plates) to study their influence on final radiative transfer results. This information will be applied to the study of atmospheric pollutants by infrared radiation measurement. (Author) (GRA)

40180 (PB—255454) **A diffraction technique to measure size distribution of large airborne particles. Final report, Dec 1973—Dec 1975.** McSweeney, A. (Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station). Jul 1976. 58p. NTIS $4.50.

The purpose of this project is to test and demonstrate a coherent optical diffraction technique for measuring the size distribution of large particles. This technique is based on the generation of a transformation matrix which is used to relate the measured diffraction patterns to the size distribution of the samples that produced the patterns. Four types of samples are considered: (1) pinholes in opaque discs, (2) photographic transparencies with opaque circular spots, (3) particles deposited on microscope slides, and (4) aerosols. Computer simulations are performed to assess the accuracy and resolution of the techniques. Although good results are obtained for pinholes in opaque discs, experimental difficulties limit the precision of this technique applied to particles in a transparent medium. Improvements based on a reduction of system noise and an increase in detector sensitivity are discussed and applied to the requirements on number density and size range of particles in a transparent medium. (GRA)

40181 (PB—257707) **Radiative effects of pollutants on the planetary boundary layer. Interim report.** Venkatram, A.; Viskanta, R. (Purdue Univ., Lafayette, Ind. (USA). School of Mechanical Engineering). Jul 1976. 262p. NTIS $9.00.

The objective of this study was to gain a better understanding of the effects of pollutants on the thermal structure and pollutant dispersal in the planetary boundary layer. To this end numerical models of the boundary layer were constructed. Gaseous pollutants in the boundary layer were considered to absorb and emit thermal radiation, while aerosols were allowed to absorb and scatter solar energy. First, a one-dimensional numerical model of the boundary layer was constructed. The model used the two-stream method for the computation of radiative fluxes, and a turbulent kinetic energy model to account for turbulence. A series of numerical experiments were performed to determine the role of pollutants in modifying thermal structure and pollutant dispersal in the boundary layer. The results showed that the predominant influence of gaseous and particulate pollutants on surface temperature was warming. The second phase of the study involved the construction of a two-dimensional numerical model to study the effects of pollutants on urban-rural differences in thermal structure and pollutant dispersal. The effects of pollutants on pollutant dispersal were found to be significant. (GRA)

40182 **Wet plume rise from cooling towers in strong winds.** Stephen, D.W.; Moroz, W.J. (Pennsylvania State Univ., University Park). *Water, Air, Soil Pollut.;* 6: No. 1, 9-24(Aug 1976).

A mathematical model is presented that predicts, as a function of distance downwind, the height of the center line of a single visible plume from a wet natural-draft cooling tower in moderate to strong winds. The analytic method is quasi-Lagrangian; that is, the behavior of a small section or parcel of the plume is analyzed as a function of time. Eight first-order differential equations describe the parcel in terms of change in mass, vertical velocity, vertical displacement, length of side, temperature, mass of liquid water, horizontal velocity, and horizontal displacement. The equations are tractable for solution by well-known computer integration techniques. The model was tested on plumes from four cooling towers at an electric generating plant, and its predicted plume path was compared with data interpreted from time-lapse photographs of the plumes. Best results were obtained by applying dry plume entrainment rates in the early stages and cloud entrainment rates in the later stages. The computed prediction, employing reasonable estimates where necessary, closely approximated the photographic data for a distance of 1500 m downwind on a day with high relative humidity. The model can also be used to analyze the nature of wet plume behavior.

40183 **Pollutant transfer into water bodies.** Brtko, W.J.; Kabel, R.L. (Pennsylvania State Univ., University Park). *Water, Air, Soil Pollut.;* 6: No. 1, 71-95(Aug 1976).

Although considerable effort has been devoted to the development of air pollution models, little has been done to incorporate natural mechanisms capable of removing pollutants from the atmosphere. One important process is the uptake of atmospheric pollutants by water bodies. In the paper, a calculational scheme to quantify this transport process is presented. In particular, two models characterizing wind induced turbulence in a water body are invoked to estimate the liquid phase mass transfer coefficient. A priori specification of parameters yielded predictions well within an order of magnitude of experimental evidence in both the laboratory and the field.

40184 (PB—258168) **Systems for rapid ranking of environmental pollutants. Selection of subjects for scientific and technical assessment reports. Final report.** Brown, S.L.; Holt, B.R.; McCaleb, K.E. (Stanford Research Inst., Menlo Park, Calif. (USA). Center for Resource and Environmental Systems Studies). Aug 1976. Contract EPA-68-01-2940. 270p. (CRESS—2). NTIS $9.00.

This document reports the results of the development and testing of a system for rapidly ranking environmental pollutants. One potential use for the system is in choosing the most important candidates for Scientific and Technical Assessment Reports (STAR). Of several possible approaches to ranking environmental agents, a system depending on expert opinion but assisted by an objective subsystem was selected for development. The system defines procedures for collecting, processing, and evaluating data on production and use; environmental transport, transformation, and rate; and human health and welfare and ecological effects. A test of the objective subsystem confirmed the utility of the system. Of ten candidate agents, the three highest ranked were cyanides, carbon disulfide, and beryllium. (GRA)

40185 Adsorption of sulfur dioxide by KB-4 and KNP-IV ionites. Subbotin, A.I.; Trachenko, V.I. *Sov. Chem. Ind. (Engl. Transl.);* **8**: No. 9, 716-718(Sep 1976).

Translated from Khim. Prom.; 8: No. 9, 681-683(1976).

The article examines sulfur dioxide adsorption on the granular ionite KB-4 and its fiber analog KNP-1V at 25°C with a moisture content of the gas-air stream (GAS) of 70 ref percent. It establishes that when the SO_2 concentration in the GAS is reduced from 29.5 to 3.1 mg/liter the equilibrium activity of the KB-4 ionite practically does not change, while that of the fiber KNO-1V noticeably decreases. When the SO_2 concentration in the GAS decreases, the dynamic activity of KB-4 increases, while that of KNP-1V decreases. Effective coefficients of mass transfer for both ionites are calculated.

40186 Personal sampler for nitrogen dioxide. Palmes, E.D.; Gunnison, A.F.; DiMattio, J.; Tomczyk, C. (New York Univ., NY). *Am. Ind. Hyg. Assoc. J.;* **37**: No. 10, 570-577(Oct 1976).

A new type of personal sampler for gases in air, originally reported from this laboratory, has been adapted to measurement of NO_2. The sampler depends on the transfer of NO_2 by diffusion to a triethanolamine coated collector at the sealed end of a tube; the open end of the tube is exposed to the test environment. The devices are accurate, light, simple to use and have very good shelf life before and after sampling.

40187 Molecular analysis of sulfate species in environmental aerosols using chemical ionization mass spectrometry. Harvey, T.M.; Schuetzle, D. Warrendale, PA; Society of Automotive Engineers (1977). 7p. (CONF-770205—48).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, United States of America (USA) (28 Feb 1977).

Speciation of sulfurous acid, sulfuric acid and ammonium sulfate collected from the aerosol phase on a Fluoropore filter has been readily accomplished using techniques of chemical ionization mass spectrometry combined with thermal separation. Thermal separation of ammonium hydrogen sulfate from ammonium sulfate was not possible. Spectral separation of these species by selective ionization is proposed. Analysis of sulfate aerosols collected from ambient air and catalyzed vehicle emissions is described. It was found that sulfuric acid aerosol was rapidly converted to ammonium sulfate or ammonium hydrogen sulfate in the presence of ambient concentrations of ammonia. Ambient samples collected in the Detroit metropolitan area have been found to contain only trace quantities of sulfuric acid. Sulfate samples collected from a dilution tube into which catalyzed vehicle exhaust was injected were found to contain significant quantities of ammonium sulfate in addition to sulfuric acid. The rate of sulfate specie volatilization from the filter media was found to be markedly affected by the ammonium sulfate particle size on the filter, thus necessitating the generation of appropriate standards. Impregnation of the collection filter with an appropriate material that will convert sulfuric acid upon collection to a species which is unaffected by ambient ammonia concentrations can permit subsequent quantitation of ambient H_2SO_4 by mass spectrometry.

40188 Apparent effect of the oil embargo on total suspended particulate matter and vanadium in New York City air. Kleinman, M.T.; Bernstein, D.M.; Kneip, T.J. (New York Univ., NY). *J. Air Pollut. Control Assoc.;* **27**: No. 1, 65-67(Jan 1977).

Air quality in New York City between 1967 and 1974 was improved by a program of pollution control which caused the sulfur content of fuel oils to be reduced from about 2.2% to 0.3%. However, the oil embargo created a shortage in the supply of low sulfur residual fuel oil, which had to be met through the use of high sulfur fuels. An increase in total suspended particulate matter and vanadium contents in New York City air and the burning of high sulfur fuels during the embargo period makes it highly probable that these events are related. (CAF)

40189 Investigation of waste oil disposal by direct incineration. LePera, M.E.; DeBono, G. (Army Mobility Equipment Research and Development Command, Fort Belvoir, VA). *J. Air Pollut. Control Assoc.;* **27**: No. 2, 144-146(Feb 1977).

The combustion-emissions programs conducted were of a short term basis to determine compliance with existing stack emissions regulations. No attempt was made to assess potential deleterious effects after long term applications of waste oil disposal. The programs completed demonstrated that up to 25 to 27 percent waste oil can be incinerated without attendant stack emissions problems. It should be noted that this combination of a heavy waste oil and the burner system used (rotary cup atomizers) essentially represented a worst case situation. Other burner systems employing steam-assist atomizers could be expected to produce substantially lower particulate emissions. Attempts to combust 100 percent waste oil were not explored since previous investigations have revealed the potential for serious problems.

40190 Cyclic trends in Los Angeles fine particulates. Porch, W.M.; Ellsaesser, H.W. (Univ. of California, Livermore). *J. Air Pollut. Control Assoc.;* **27**: No. 2, 134-137(Feb 1977).

Noontime visibilities in downtown Los Angeles, averaged over the smog season of June through November, show two cycles of general deterioration and improvement. The improvement since 1962 is confirmed by available high volume filter data and conditions in 1974/75 are at least as good as at anytime since observations were begun in 1933. The decrease in frequency of "rule 57" days suggests that the improvement of the last decade and perhaps the cyclic variation of the past 40 years have been primarily of meteorological origin.

40191 Mechanism of olefin—ozone reactions. Walter, T.A.; Bafalini, J.J.; Gay, B.W. Jr. (Environmental Sciences Research Lab., Research Triangle Park, NC). *Environ. Sci. Technol.;* **11**: No. 4, 382-386(Apr 1977).

The gas-phase reaction of 2-butene with ozone is investigated. By use of experimentally obtained disappearance and formation rates, intermediates are proposed that when modeled explain the nonstoichiometric behaviors of olefin—ozone reactions. The oxidation of SO_2 in the presence of O_3 and 2-butene is also investigated. A biradical is not needed in the oxidation of SO_2. Instead, the SO_2 can be explained solely by its reaction with intermediates such as OH, O_2H, and CH_3O_2 that are produced in ozone—olefin reactions.

40192 Monitoring the quality of ambient air. Morgan, G.B. (Environmental Protection Agency, Las Vegas, NV). *Environ. Sci. Technol.;* **11**: No. 4, 352-357(Apr 1977).

Monitoring for air quality is a very complex operation, one which requires a pollutant-specific systematic approach. It can furnish data to be used to set standards, assure compliance, develop controls, and anticipate problems. Air monitoring activities may be divided into permanent fixed-site (trend) monitoring, exposure monitoring, ambient-source-linked monitoring, and biological monitoring. To provide valid data on pollutant concentrations, an air quality monitoring network must have: a central laboratory facility, a manual sampling network, an automatic network, and support facilities. Future monitoring systems must be able to detect potential problems and monitor the appropriate parameters before they reach crisis proportion. (CAJ)

40193 Atmospheric chemistry of N-nitroso dimethylamine. Hanst, P.L.; Spence, J.W.; Miller, M. (Environmental Protection Agency, Research Triangle Park, NC). *Environ. Sci. Technol.;* **11**: No. 4, 403-405(Apr 1977).

Gaseous dimethylamine, $(CH_3)_2NH$, reacts in air with gaseous nitrous acid, HONO, to yield N-nitroso dimethylamine, $(CH_3)_2NNO$. Long path infrared spectroscopy is used to monitor these reactions at concentration levels of parts-per-million. The measured reaction rate shows that a small degree of nitrosation of dimethylamine vapor might take place during the night in a heavily polluted urban atmosphere. Nitrosation reactions would essentially cease after sunrise because the nitrous acid would be destroyed by photolysis. The N-nitroso dimethylamine vapor is also destroyed by sunlight, the half-life under full sun being about 30 min. By midday any nighttime accumulation of nitrosamine would be rather fully destroyed. Any N-nitroso dimethylamine detected in the air in the afternoon could not be the result of the reaction of precursors. It could only be the result of direct emissions of the pollutant.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 39324, 39353, 40492

40194 (ANL/ES—26) Argonne Radiological Impact Program (ARIP). Part II. MONITOR: a program and data base for retrieval and utilizaton of pollutant monitoring data. Eckerman, K.F.; Stowe, R.S.; Frigerio, N.A. (Argonne National Lab., Ill. (USA)). Feb 1977. Contract W-31-109-ENG-38. 116p. P 06/MF A01.

The Argonne Radiological Impact Program (ARIP) is an ongoing project that aims at developing methodologies for assessing the carcinogenic hazards associated with nuclear power development. The current report (Part II) treats the storage and access of available data on radiation and radioactivity levels in the U.S. A computer code (the MONITOR program) is presented, which can serve as a ready-access data bank for all monitoring data acquired over the past two decades. The MONITOR program currently stores data on monitoring locations, types of monitoring efforts, and types of monitoring data reported in Radiation Data and Reports by the various state and federal networks; expansion of this data base to include nuclear power facilities in operation or on order is on-going. The MONITOR code retrieves information within a search radius, or rectangle, circumscribed by parameters of latitude and longitude, and lists or maps the data as requested. The code, with examples, is given in full in the report.

40195 (BNWL—2081) **Radioactive particle resuspension research experiments on the Hanford Reservation.** Sehmel, G.A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1977. Contract EY-76-C-06-1830;EY-76-C-06-2130. 47p. P 03/MF A01.

Experiments were conducted from 1972 to 1975 at several Hanford Reservation study sites to determine whether radioactive particles from these sites were resuspended and transported by wind and to determine, if possible, any interrelationships between wind speed, direction, airborne soil, and levels of radioactivity on airborne particles. Samples of airborne particles were collected with high volume air samplers and cascade particle impactors using both upwind and downwind air sampling towers. Most samples were analyzed for ^{137}Cs; some samples were analyzed for ^{239}Pu, ^{238}Pu and ^{241}Am; a few samples were analyzed for ^{90}Sr. This report summarizes measured air concentration ranges for these radionuclides at the study sites and compares air concentrations with fallout levels measured in 300 Area near the Reservation boundary.

40196 (CONF-750671—) **International symposium on areas of high natural radioactivity.** Cullen, T.L.; Penna Franca, E. (eds.). (Pontificia Universidade Catolica do Rio de Janeiro (Brazil)). 1975. Contract EY-76-C-02-2592. 191p. P 09/MF A01.

From International symposium on areas of high natural radioactivity; Pocos de Caldas, Brazil (16 Jun 1975).

Twelve papers and abstracts of nine papers are included that were presented at a conference to review what is known about the world's natural radioactive anomalies and their biological implications was held in Pocos de Caldas, Minas Gerais, Brazil, June 16 to 20, 1975. Pocos de Caldas was selected as the site of the symposium because of its proximity to Morro do Ferro, a hill on which the external radiation level is as much as 300 times normal. The natural thorium in the rocks and soils give a remarkable exposure to the native flora and fauna due to the absorption of nuclides. Other reported radioactive anomalies are the monazite sand areas of Brazil and India, and a number of places throughout the world in which the radioactivity of drinking water and certain foods are known to be elevated above normal to a significant degree. The objectives of the symposium were: to inventory those places in the world where such anomalies are known to exist; to review the status of investigations being conducted; and to assess the extent to which research in such places can add much needed information on the effects of low level exposure to ionizing radiation. For the purpose of this symposium, an anomalous radioactive environment was defined as one that is characterized by one or more of the following: the exposure rate from external terrestrial sources, over extended areas, is greater than 200 mR/yr; the long lived alpha activity, ingested with the local diet and water, is greater than 50 pCi/day; the radon-222 concentration of potable water is greater than 5000 pCi/l; and the radon 220 and 222 concentration of the atmosphere is greater than 1 pCi/l. Abstracts of two of the papers appeared previously in ERA.

40197 (ERDA—77-24) **Guide for environmental radiological surveillance at ERDA installations.** Corley, J.P.; Denham, D.H.; Michels, D.E.; Olsen, A.R.; Waite, D.A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Mar 1977. Contract EY-76-C-06-1830. 218p. P 10/MF A01.

This Guide is intended to: Provide recommended methods, procedures, and performance criteria to bring greater comparability to ERDA environmental monitoring and reporting systems; provide ERDA management, particularly the Headquarters' Division of Safety, Standards, and Compliance (SSC) and field offices, with a broad review of accepted radiological surveillance practices for use in the evaluation of environmental surveillance programs at ERDA facilities; and delineate the capabilities and limitations of the various environmental monitoring systems for radioactivity currently used at ERDA sites, including technical areas where there is either an inadequate basis for procedural selection or where further developmental work may be warranted. The discussion of equipment, measurement techniques, and quality control procedures, although believed to represent current technology, is subject to continuing change as technological improvements become available. (235 references)

40198 (GEPP—288) **Environmental monitoring report, 1976.** (General Electric Co., St. Petersburg, Fla. (USA). Pinellas Peninsula Plant). 20 Apr 1977. Contract EY-76-C-04-0656. 41p. P 03/MF A01.

The effluent and environmental monitoring programs maintained by the Pinellas Plant are designed to determine the efficiencies of treatment and control mechanisms; to provide measurements of discharge concentrations for comparison with applicable standards; and to assess the concentrations of these discharges in the environment. Site perimeter and off-site air samples for tritium gas and tritium oxide, as well as off-site surface water samples obtained to distances of 9.6 kilometers (6 miles) from the plant site and analyzed for tritium content, showed levels significantly less than $^1/_{10}$ of 1 percent of the recommended guide for continuous nonoccupational exposure. Small sealed plutonium sources are utilized at this site. No plutonium was released to the environment and monitoring data showed environmental background levels.

40199 (LBL—6405) **Annual environmental monitoring report of the Lawrence Berkeley Laboratory.** Stephens, L.D. (ed.). (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1977. Contract W-7405-ENG-48. 40p. P 05/MF A01.

The data obtained from the Environmental Monitoring Program of the Lawrence Berkeley Laboratory for the calendar year 1976 are described and general trends are discussed. Reference is made to LBL-4678, the 1976 annual report that discusses in detail the modeling used to determine the population dose equivalent due to laboratory operations and describes natural background radiation, geological features, climate and meteorology, and the environmental surveillance program.

40200 (NLCO—1142) **Feed materials production center environmental monitoring annual report, 1976.** Boback, M.W.; Ross, K.N.; Fuchs, D.A. (National Lead Co. of Ohio, Cincinnati (USA)). 1 Apr 1977. Contract EY-76-C-05-1156. 36p. P 03/MF A01.

This report contains environmental monitoring data collected at the Feed Materials Production Center during 1976. These data show that the average boundary concentrations of airborne radioactive contaminants from FMPC operations were no greater than 0.5 percent of the guide levels published in ERDA Manual Chapter 0524. The resulting offsite radiation exposures would, therefore, be a small fraction of the standards for uncontrolled areas. Radionuclides in wastewater did not present a significant potential for radiation exposure. Data are included on the content of uranium in soil samples from various depths and in sediments in the Miami River. Concentrations of environmentally important non-radioactive contaminants in water and air are also reported. Results show that FMPC operations did not cause State standards for these contaminants to be exceeded.

40201 (ORNL/TM—5830) **Compilation of documented computer codes applicable to environmental assessment of radioactivity releases.** Hoffman, F.O.; Miller, C.W.; Shaeffer, D.L.; Garten, C.T. Jr.; Shor, R.W.; Ensminger, J.T. (Oak Ridge National Lab., Tenn. (USA)). Apr 1977. Contract W-7405-ENG-26. 83p. P 05/MF A01.

The objective of this paper is to present a compilation of computer codes for the assessment of accidental or routine releases of radioactivity to the environment from nuclear power facilities. The capabilities of 83 computer codes in the areas of environmental transport and radiation dosimetry are summarized in tabular form. This preliminary analysis clearly indicates that the initial efforts in assessment methodology development have concentrated on atmospheric dispersion, external dosimetry, and internal dosimetry via inhalation. The incorporation of terrestrial and aquatic food chain pathways has been a more recent development and reflects the current requirements of environmental legislation and the needs of regulatory agencies. The characteristics of the conceptual models employed by these codes are reviewed. The appendixes include abstracts of the codes and indexes by author, key words, publication description, and title.

40202 (SAND—77-0616) **Environmental monitoring report: Sandia Laboratories, 1976.** Simmons, T.N. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1977. Contract EY-76-C-04-0789. 23p. P 02/MF A01.

Water and vegetation are monitored to determine Sandia Laboratories impact on the surrounding environment. Nonradioactive pollutants released are reported. Radioactive effluents are also reported and their person-rem contribution to the Albuquerque population is calculated. The environmental monitoring for calendar year 1976 shows that concentrations of radioactive materials in the Albuquerque area are typical of natural background for the area. An exception is a single onsite location where slightly abnormal uranium concentrations are expected. An estimated 0.044 person-rem Albuquerque area (80 km radius) population dose commitment results from calculated Sandia Laboratories releases. Over the same area 57,000 person-rem is accumulated from natural background. There were no measurable offsite radioactive effluent releases in CY 1976.

40203 (PB—255576) **Radioactivity levels in the environs of the Rocky Flats Plutonium Plant, Colorado, 1970. Part II.** (Environmental Protection Agency, Denver, Colo. (USA)). 15 Dec 1973. 33p. (SA/TIB—26). NTIS $4.00.

The report presents the findings of the September 1970 environmental radiation study conducted in the environs of the Rocky Flats Plutonium Plant (near Golden, Colorado). The field study and subsequent laboratory analyses were conducted by the staff of the Radiological Activities Section, Division of Technical Support, Water Quality Office, Environmental Protection Agency, Cincinnati, Ohio (an organizational unit of the Federal Water Quality Administration at the time of the study; reorganized into EPA in December 1971). Due to personnel transfers and changes in program responsibilities, a report on the study was not completed by the Radiological Activities Section prior to its dissolution from the EPA organizational structure during the first half of 1973. Since the primary investigators are now members of the Technical Investigations Branch, Surveillance and Analysis Division, and the environ-

mental impact of the Rocky Flats Plant is a Region VIII concern, publication is undertaken as a regional responsibility. (GRA)

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 39658

REGULATIONS

REFER ALSO TO CITATION(S) 39660

40204 National coping styles: policies to combat environmental problems. Wall, G. (Univ. of Waterloo, Ont.). *Int. J. Environ. Stud.;* **9**: No. 4, 239-245(1976).

This paper examines the anti-pollution strategies adopted in the United Kingdom and the United States. Using selected examples drawn from air and water pollution and noise abatement as supporting evidence, it is suggested that there has been a tendency to designate standards and to enforce these by legal sanctions in the United States, while Britain has tended to avoid setting standards and has relied more upon persuasion and cooperation. Distinct national coping styles may exist which predispose some nations to adopt particular types of anti-pollution strategy and to reject others. This has important implications for the international transfer of abatement technologies.

ENVIRONMENTAL SCIENCES, TERRESTRIAL

REFER ALSO TO CITATION(S) 40120

BASIC STUDIES

REFER ALSO TO CITATION(S) 40121

40205 (CONF-770209—1) **Application of analytic and mechanistic hydrologic models to the study of Walker Branch Watershed.** Huff, D.D.; Henderson, G.S.; Begovich, C.L.; Luxmoore, R.J.; Jones, J.R. (Oak Ridge National Lab., Tenn. (USA)). 1977. Contract W-7405-ENG-26. 30p. P 03/MF A01.

From Lake Jackson watershed study) description of sites, methodology and scope of research; Edgewater, Maryland, United States of America (USA) (28 Feb 1977).

Hydrologic studies at Walker Branch Watershed combine field data collection, use of analytic methods for data processing, and the use of models to explore hypotheses that result from analysis. For example, examination of delayed flow from the two sub-basins of Walker Branch showed a quantitative exchange from one sub-basin to the other. The data also suggested a relationship between delayed flow rate and fraction of delayed flow volume exchanged. Simulation results supported the analysis, but raised additional questions for further field study and data analysis. A similar approach to studies of quick-flow and evapotranspiration leads to a suggestion that storm runoff is uniform for both sub-basins and is related to the moisture content of surface soils, as influenced by evapotranspiration.

40206 (CONF-770209—2) **Hydrologic characteristics of Walker Branch Watershed.** Henderson, G.S.; Huff, D.D.; Grizzard, T. (Oak Ridge National Lab., Tenn. (USA)). 1977. Contract W-7405-ENG-26. 15p. P 02/MF A01.

From Lake Jackson watershed study) description of sites, methodology and scope of research; Edgewater, Maryland, United States of America (USA) (28 Feb 1977).

Walker Branch Watershed, a 97.5 ha deciduous forest catchment on dolomitic terrain, received annual precipitation averaging 151.1 cm over a six-year period from 1970-1976. Approximately 56 percent of this precipitation left the watershed as streamflow. Soil evaporation and canopy interception with subsequent evaporation loss were well represented by relationships derived for eastern hardwoods and amounted to about 12 percent of precipitation. Transpiration accounted for the remainder (31 percent) of the water loss from the watershed. Seasonal precipitation-streamflow balances show that precipitation is relatively uniformly distributed throughout the year, while streamflow varies seasonally with high flows from December through May and low flows from June through November. Baseflow discharge patterns from the two subcatchments are different, the smaller basin yielding relatively more than the larger one. This difference is thought to be due to groundwater exchange between the two through channels in the dolomitic bedrock. The hydrologic data base is used extensively in nutrient and trace element cycling studies and in development of mechanistic hydrologic models.

40207 (EDFB/IBP—76/8) **TEHM: a terrestrial ecosystem hydrology model.** Huff, D.D.; Luxmoore, R.J.; Mankin, J.B.; Begovich, C.L. (Oak Ridge National Lab., Tenn. (USA)). Apr 1977. Contract W-7405-ENG-26;NSF-INA-AG-199;DEB76-00761. 160p. (ORNL/NSF/EATC—27). P 09/MF A01.

Report contains two microfiche enclosures available as MF only.

The terrestrial ecosystem hydrology model (TEHM) combines mechanistic models for climatic and hydrologic processes with vegetation properties to explicitly simulate interception and throughfall; infiltration; root zone evaporation, transpiration, and drainage; plant and soil water potential; unsaturated and saturated subsurface flow; surface runoff; and open channel flow. It is also possible to use the TEHM with models for forest stand biomass dynamics and chemistry and exchange of heavy metals to study the transport and fate of trace contaminants at a watershed scale. Walker Branch Watershed has been used as an example to illustrate development of the required input parameters and variables that are necessary to execute the TEHM. In all cases, emphasis has been placed on objective, physically based methods. When simulations of interception loss, soil moisture content, and base flow and storm flow are compared with observation, the overall adequacy of the model may be assessed. For user convenience, the documentation includes a complete discussion of input formats, example data input sets, output summaries, and a microfiche listing of the complete source deck and program output. As presented, the TEHM provides an operational tool and a model structure and data management capabilities that will be useful for future hydrologic simulation work. From that viewpoint, the TEHM represents an important step forward in establishment of an objective framework for the study of terrestrial ecosystems.

40208 Natural dust and acid rain. Winkler, E.M. (Univ. of Notre Dame, IN). *Water, Air, Soil Pollut.;* **6**: No. 2/3/4, 295-302(1976).

Atmospheric dust originates from three sources; terrestrial airborne matter, volcanic, and cosmic. Terrestrial natural dust makes up the main bulk reflecting the soil composition to 150 mi away. Soil erosion from flood plains, plowed fields and construction sites is the main source. Quartz, feldspar, the carbonates calcite and dolomite, and clay minerals are the components in decreasing order of frequency. Natural dust in the atmosphere interacts with rainwater converting the carbonates to benign gypsum ($CaSO_4.2H_2O$). Naturally leached soils produce less calcite than unweathered sediments on flood plains and construction sites, and in granitic and crystalline rocks less than in limestone areas. Heavy industrialization associated with high emission of CO_2 and SO_2 on the one hand, and excess production of dust on the other appears to counteract man's interference with natural ecosystems in the opposite direction.

40209 Rainfall and fluctuating plant populations in relation to distributions and numbers of desert rodents in southern Nevada. Beatley, J.C. (Univ. of Cincinnati). *Oecologia (Berlin);* **24**: 21-42(1976).

Fluctuations in rainfall and size of desert rodent and plant populations for each of five consecutive years were documented on 68 sites in Mojave, Great Basin, and transition desert communities of central-southern Nevada. Post-reproduction rodent densities in the summer usually followed the seasonal patterns of winter annual success the previous spring, in turn directly related to the success of germination the preceding autumn. In the Dipodomys merriami environment, at the lower elevations with relatively low rainfall and high temperatures of the Mojave Desert, D. merriami and D. deserti numbers (indicating success or failure of reproduction) closely followed the seasonal and site patterns of winter annual success. In the Dipodomys microps environment, at the middle and higher elevations with the relatively high rainfall and lower temperatures of the transition and Great Basin deserts, D. microps numbers followed winter annual success patterns in years of high or low rainfall in the months preceding reproduction, but there was reproduction in years of intermediate rainfall whether or not there were winter annuals in the environment. Reproductive patterns of D. merriami in the D. microps environment followed those of D. microps. Perognathus longimembris, the ubiquitous heteromyid of the region, also exhibited both reproductive patterns, depending on whether it was in the D. merriami or the D. microps environment. The Mojave Desert P. formosus, edaphically restricted in the region, followed the patterns of the D. merriami environment and its numbers were highly correlated with winter annual success. Herbaceous perennials, capable of large germinations of plants behaving as biennials or winter annuals, are shown to have large effects on D. merriami numbers. Size of populations of Eurasian annual species of Bromus and Salsola were not correlatable with rodent reproduction patterns.

RADIOMETRIC TECHNIQUES

REFER ALSO TO CITATION(S) 40213

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 40019, 40129, 40200, 40202

40210 **Molybdenum hazard in land disposal of sewage sludge.** Lahann, R.W. (State Univ. of New York, Binghamton). *Water, Air, Soil Pollut.;* 6: No. 1, 3-8(Aug 1976).

The application of sewage sludge to agricultural fields may result in the production of Mo-rich herbage, a cause of metabolic disorders in animals. An alternative to application of sludge to agricultural fields is sludge utilization in strip-mine reclamation. Oxidation of strip-mine spoil material causes accumulation of Mo-rich iron oxyhydroxide in stream beds and spoil piles. Strip-mine reclamation by sludge application may induce short-term increases in the concentration of Mo and other metals in waters discharged from the reclaimed area because of pH dependent ion-exchange reactions and dissolution of Mo-bearing iron oxyhydroxides.

40211 **Pb adsorption by soils. II. Specific adsorption.** Riffaldi, R.; Levi-Minzi, R.; Soldatini, G.F. (Univ., Pisa, Italy). *Water, Air, Soil Pollut.;* 6: No. 1, 119-128(Aug 1976).

Adsorption of Pb by soils in the presence of a large amount of Ca was studied. Adsorption was found to conform to the Langmuir and Freundlich isotherms over a large range of concentrations. Organic matter and clay were the dominant constituents contributing towards adsorption maxima for soils. In addition to the parameters derived from two isotherms, the following parameters, initial slope of the isotherms and 1/C at equilibrium for theta = 0.5, were also investigated. The affinity of Pb for sorption sites in soil decreased logarithmically with an increase of surface coverage. Different adsorption mechanisms of Pb in presence and absence of Ca are discussed.

40212 **Pb adsorption by soils. I. Adsorption as measured by the Langmuir and Freundlich isotherms.** Soldatini, F.F.; Riffaldi, R.; Levi-Minzi, R. (Univ. of Pisa, Italy). *Water, Air, Soil Pollut.;* 6: No. 1, 111-118(Aug 1976).

Pb adsorption for 12 soils from Tuscany was studied. The data fitted the Langmuir and the Freundlich isotherms over a large range of concentrations. Results showed that organic matter and clay content were responsible for adsorption maxima. The effect of Mn oxides, explained independently of organic matter and clay, was negligible. The adsorption maxima were generally found to be greater than CEC; the possible mechanisms are discussed.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 39317, 39353, 40196, 40197, 40200, 40202, 40203, 40247, 40492

40213 (LA—6731-MS) **Experience in the cleanup of plutonium-contaminated land.** Smith, W.J. II; Fowler, E.B.; Stafford, R.G. (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1977. Contract W-7405-ENG-36. 18p. P 02/MF A01.

During the summer of 1974, two accidental releases from a radioactive liquid-waste line at the Los Alamos Scientific Laboratory (LASL) resulted in plutonium contamination of a small area of land, a portion of a Laboratory parking lot, and a strip along an adjacent street. This report documents the immediate control actions and radiation surveys made in response to these leaks, and the subsequent exhumation and decontamination processes, including the physical operations, operational health physics, and soil sample analyses. The cost and results of the decontamination and restoration are also covered.

40214 (BNWL-tr—236) **Concentration dependence of iodide sorption in various soils.** Knaelmann, M. Translated from *Atomkernenergie;* 16: 247-252(1970). 21p. P 02/MF A01.

Among all fission products, iodine-131 can be transported relatively easily in the soil. Therefore, its uncontrolled spreading can represent a source of hazard. Accordingly, the sorption of iodine by 59 different soils was investigated. The iodine was introduced in the form of aqueous iodide solutions at various concentrations. Differences were found in the relative sorption in the different soils, but the curves of relative sorption versus applied concentration exhibited similar shapes for all soils.

40215 **Determination of strontium-90 in soil samples.** Chang, C.C. (National Tsing Hua Univ., Hsinchu, Taiwan). *Nucl. Sci. J. (Taiwan);* 13: No. 2, 90-94(Jun 1976). (In Chinese).

The determination of ^{90}Sr in soil by tri-n-butyl phosphate (TBP) is often interfered with iron which is always present in soil sample. Based on the method given by the U.S. Environmental Protection Agency, $HClO_4$ is added to remove iron ions while the soil sample is analyzed with TBP. The effect of different concentrations of $HClO_4$ on extraction yield of iron and chemical yield of yttrium is investigated. The experimental results show that 2N $HClO_4$ is the optimum concentration. The chemical yield of yttrium can reach about 60 percent, and all iron ions can be removed. This method has successfully been applied to analyze the soil samples taken from the site of the nuclear power plant in North Taiwan.

SOIL

REFER ALSO TO CITATION(S) 39335, 40216

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 39335, 40196, 40369, 40370, 40371, 40372, 40373, 40374, 40375, 40399

40216 (PB—255950) **Tritium in plants and soil. Final report.** McFarlane, J.C.; Beckert, W.F.; Brown, K.W. (Environmental Protection Agency, Las Vegas, Nev. (USA). Environmental Monitoring and Support Lab.). May 1976. 40p. (EPA—600/3-76/052). NTIS $4.00.

This is a review of literature regarding the fate and consequences of tritium in plants and soils. The kinetics of tritium in plants and soils was reviewed in light of water potential terminology, and some original research data are enclosed to illustrate specific concepts. The review cites 70 articles. (GRA)

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 39430

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 39153, 39158, 39655, 39657, 39658, 39659

40217 (NP—21767) **Fort St. Vrain Nuclear Generating Station: ecological monitoring program. Progress report, July 1, 1976—December 31, 1976.** Glover, F.A. (Thorne Ecological Inst., Boulder, Colo. (USA)). 1977. 345p. Thorne Ecological Inst., Boulder, CO.

The non-radiation, environmental monitoring data presented in this report indicate a situation of little change from previous years, except for minor natural variations. Several areas of investigation have shown an improvement in environmental quality: aquatic invertebrates, fish, algae, and birds. It is difficult at this point to evaluate the effects of the Nuclear Generating Station on the environs since the Station has been in operation only a minor portion of the reporting period. Data are included on the species and population dynamics of fish, invertebrates, and algae in the St. Vrain and South Platte Rivers; the distribution by species of birds and plants in the area, and the content of Cu, Zn, Hg, Cd, and Pb in samples of river water and soil collected in the area. (CH)

40218 **Land reclamation and strip-mined coal production in Appalachia.** Lin, W.; Spore, R.L.; Nephew, E.A. (Oak Ridge National Lab., TN). *J. Embryol. Exp. Morphol.;* 3: No. 3, 236-252(1976).

The study quantifies the short-run impacts of reclamation on strip mining costs, coal prices, production, and employment in Appalachia. A process analysis model is developed and used to estimate short-run strip-mined coal supply functions under conditions of alternative reclamation requirements. Then, an econometric model is developed and used to estimate coal demand relations. Our results show that full reclamation has rather minor impacts. In 1972, full reclamation would have increased strip-mined coal production costs an average of $0.35 per ton, reduced strip-mined coal production by 10 million tons, and cost approximately 1600 jobs in Appalachia.

ENVIRONMENTAL SCIENCES, AQUATIC

REFER ALSO TO CITATION(S) 40120

BASIC STUDIES

REFER ALSO TO CITATION(S) 40121, 40205, 40206, 40352, 40450

40219 (ANL/ES—40(Vol.4)) **Environmental status of the Lake Michigan region. Volume 4. Phytoplankton of Lake Michigan.** Tarapchak, S.J.; Stoermer, E.F. (Argonne National Lab., Ill. (USA)). Dec 1976. Contract W-31-109-ENG-38. 211p. P 10/MF A01.

For nearly 100 years, studies on the phytoplankton of Lake Michigan have provided a wealth of information on the flora, its quantitative composition, and the effects of cultural eutrophication on algal abundance and species composition. The flora, consisting of over 2000 known taxa, contains species characteristic of oligotrophic and eutrophic environments. Phytoplankton abundance and primary productivity vary seasonally and generally are higher and more variable inshore than offshore. Seasonal phytoplankton development is bimodal in the southern and near-shore water of the central basin but exhibits a unimodal pattern (a peak in summer) offshore in the central basin. These dissimilarities are attributed to differential effects of critical water temperatures, higher nutrient concentrations in the southern basin, and differences in critical mixing depths. Recently there has been a significant increase in algal abundance inshore near Milwaukee and Chicago and a shift to a significant fraction of green and blue-green algae in the offshore community in the southern basin. This observation is one line of evidence suggesting that the Lake is undergoing serious cultural eutrophication due to increases in phosphorus loading rates.

40220 (CONF-770209—5) **Descriptive hydrology of three north Florida watersheds in contrasting land use. Environmental Sciences Division publication No. 1022.** Turner, R.R.; Burton, T.M.; Harriss, R.C. (Oak Ridge National Lab., Tenn. (USA)). 1977. Contract W-7405-ENG-26. 19p. P 02/MF A01.

From Lake Jackson watershed study) description of sites, methodology and scope of research; Edgewater, Maryland, United States of America (USA) (28 Feb 1977).

Results of hydrologic studies on three adjacent watersheds in north Florida representing, respectively, urban (792 ha), suburban (430 ha) and forested-agricultural (611 ha) land uses support theory and the findings of others that urbanization increases storm peak flows, increases the ratio of quickflow volume to delayed flow volume, and increases annual runoff. Total runoff losses from the forested-agricultural, suburban and urban basins during the period July 1973 to June 1975 were, respectively, 31.2, 38.1 and 48.3 cm of which 39 percent, 51 percent, and 82 percent were quickflow. Ratios of total quickflow volume to total precipitation over the study period were 0.05, 0.08, and 0.16 for the forested-agricultural, suburban and urban watersheds, respectively. Comparison of individual storm hydrographs revealed striking contrasts in the relative magnitude and temporal distribution of streamflow from these watersheds.

40221 (ORNL-tr—4271) **Horizontal distribution of zooplankton in the Mingechaursk Reservoir.** Akhmedov, I.A. Translated by S.D. Blalock Jr. from *Izv. Akad. Nauk Azerb. SSR, Ser. Biol. Nauk;* No. 5-6, 106-111(1974). 8p. P 02/MF A01.

In the Mingechaursk Reservoir the zooplankton is distributed in very spotty fashion. The seasonal distribution of zooplankton of the Mingechaursk Reservoir over the course of the year apparently has two phases: (1) Winter and Spring, when the largest zooplankton biomass is observed in the middle stretch, and the minimum in the lower and Khanabad stretches, and (2) Summer and Fall, when the maximum development is noted in the upper stretch of the reservoir. The unequal distribution of zooplankton in the Mingechaursk Reservoir depends on certain factors: water level, transparency, and the thermal regime, the direction of wind and the speed of the current, the development of the algoflora and the use of zooplankton by fish that prey on plankton.

40222 Dynamics of phytoplankton blooms in Puget Sound, a fjord in the northwestern United States. Winter, D.F.; Banse, K.; Anderson, G.C. (Univ. of Washington, Seattle). *Mar. Biol.;* **29**: No. 2, 139-176(1975).

A quantitative investigation of relationships between the growth of phytoplankton, and climatic and hydrodynamic conditions in temperate fjords with marked tides, as exemplified by Puget Sound, Washington (USA) is described. Algal growth in the open waters of the central basin of the Sound is dominated by a number of intense blooms beginning in late April or May and recurring throughout the summer. Rarely, and only briefly, does nitrate become exhausted. The phytoplankton production rate in the central basin of Puget Sound is about 465 g C m^{-2} $year^{-1}$. During the springs of 1966 and 1967, oceanographic measurements were carried out at a mid-channel station with sufficient frequency to allow investigation of physical and biological processes with time scales of the order of a day. The principal investigative tool is a numerical model in which the hydrodynamical conditions are represented by an approximate analysis of the gravitational convection mode of circulation. It is concluded that phytoplankton growth is limited by a combination of factors, including vertical advection and turbulence, modulation of underwater light intensity by self-shading and inorganic particulates, sinking of algal cells, and occasional rapid horizontal advection of the population from the area by sustained winds. The high primary productivity of the Sound is due to intensive upward transport of nitrate by the estuarine mechanism.

40223 Observations on the superficial sediment temperatures of some lakes in the southeastern United States. Lewis, W.M. Jr. (Univ. of Colorado, Boulder). *Freshwater Biol.;* **6**: No. 1, 49-57(Feb 1976).

Temperatures of the water column and upper 5 cm of sediment were monitored over a yearly cycle in two South Carolina lakes. Occasional supportive data were also obtained for several lakes in north central Florida. Plans are given for a new type of sediment—interface sampler that is useful in obtaining detailed temperature or chemical profiles extending from the sediment surface upward. The sampler was used in the investigation to demonstrate the thermal microstratigraphy near the mud surface. The deep-water (16 m) temperature for the larger of the two South Carolina lakes changes seasonally from 10.5°C in February to 18.0°C in July. The smaller, shallower (11 m) lake follows an almost identical seasonal cycle but is always 4.0°C cooler because the larger lake receives a heated effluent that has a long-term effect on hypolimnetic temperatures. In both lakes the uppermost sediments are warmer than the overlying water by an average of 0.1 to 1.0°C during the warming period. The coldest water is located in a thin layer just over the sediment. There is evidence that when the density flows begin they at first flow over a warmer water layer that is more dense due to a high electrolyte content derived from the sediment. It is concluded that the sediment—water interface of a warm lake will in general experience greater heat flux than that of a comparable cold lake during the periods of temperature maximum and minimum. Conversely, there is likely to be less heat flux during the warming and cooling periods of warm lakes than of cold lakes. Several expected differences in seasonal patterns of temperature and water movement in the deep water of warm and cold lakes are discussed.

40224 Occurrence of the woodborer, Limnoria lignorum (Rathke) at Amchitka Island, Alaska. Richards, B.R.; Belmore, C.I. (Battelle-Columbus Labs., Duxbury, MA). *J. Fish. Res. Board Can.;* **33**: No. 7, 1642-1644(Jul 1976).

Three hundred and sixty-one Limnoria specimens collected from wood pilings at Amchitka, Alaska in 1971 and 1974 were all identified as Limnoria lignorum (Rathke). This is believed to be the first record of the species on Amchitka. The discovery fills a gap in the known distribution between the west and east coasts of the North Pacific Ocean. Female specimens outnumbered males approximately two to one.

40225 Macrophyte-epiphyte biomass and productivity in an eelgrass (Zostera marina L.) community. Penhale, P.A. (North Carolina State Univ., Raleigh). *J. Exp. Mar. Biol. Ecol.;* **26**: No. 2, 211-224(1977).

The biomass, productivity (^{14}C), and photosynthetic response to light and temperature of eelgrass, Zostera marina L. and its epiphytes was measured in a shallow estuarine system near Beaufort, North Carolina, during 1974. The maximum of the biomass (aboveground) was measured in March; this was followed by a general decline throughout the rest of the year. The average biomass was 105.0 g dry wt m^{-2}; 80.3 g dry wt m^{-2} was eelgrass and 24.7 g dry wt m^{-2} was epiphytes. The productivity of eelgrass averaged 0.88 mg C g^{-1} h^{-1} which was similar to that of the epiphytes, 0.65 mg C g^{-1} h^{-1}. Eelgrass and epiphyte productivity was low during the spring and early summer, gave a maximum during late summer and fall, and declined during the winter; this progression was probably due to environmental factors associated with tidal heights. On an areal basis, the average annual productivity was 0.9 g C m^{-2} day^{-1} for eelgrass and 0.2 g C m^{-2} day^{-1} for the epiphytes. Rates of photosynthesis of both eelgrass and epiphytes increased with increasing temperature to an asymptotic value at which the system was light saturated. Both eelgrass and epiphytes had a temperature optimum of <29°C. A negative response to higher temperatures was also reflected in biomass measurements which showed the destruction of eelgrass with increasing summer temperatures. The data suggest that the primary productivity cycles of macrophytes and epiphytes are closely interrelated.

40226 Maximum depth inhabited by aquatic vascular plants. Sheldon, R.B.; Boylen, C.W. (Rensselaer Polytechnic Inst., Troy, NY). *Am. Midl. Nat.;* **97**: No. 1, 248-254(Jan 1977).

In situ observations of submerged, rooted aquatic plants by a diver equipped with SCUBA have shown that the maximum depth distribution of a number of submerged species in a clear freshwater lake (Lake George, New York) is greater than previously reported. Maximum depth for any species was 12 m for Elodea canadenis. Water clarity is sufficient to allow 10 percent of the light intensity hitting the surface during midsummer to penetrate to this depth. The number of submergent species drops linearly from 38 at 1 m to one at 12 m. Data are presented for the maximum depth of occurrence for

28 vascular macrophyte species, and population densities of these species at their preferred and maximum growth depths compared. The effect of several environmental parameters on depth inhabited by rooted aquatics is discussed.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 39123, 39128, 39129, 39247, 39248, 40127, 40129, 40173, 40174, 40183, 40184, 40198, 40200, 40202, 40462, 40469, 40474, 40476, 40481

40227 (CONF-770209—3) **Dynamics of trace element export from a deciduous watershed, Walker Branch, Tennessee.** Turner, R.R.; Lindberg, S.E.; Talbot, K. (Oak Ridge National Lab., Tenn. (USA)). 1977. Contract W-7405-ENG-26. 24p. P 02/MF A01.

From Lake Jackson watershed study) description of sites, methodology and scope of research; Edgewater, Maryland, United States of America (USA) (28 Feb 1977).

As part of an integrated study of trace contaminant behavior on a landscape scale, concentrations of several trace elements in both dissolved and particulate form were measured regularly in streamflow from Walker Branch Watershed during the period September 1975 to August 1976. In general Cd, Cu, and Cr were transported primarily in dissolved form, with the relative fraction in particulate form increasing during storms. Iron and Mn, responding to the high pH (approximately 8.0) and oxygenated conditions of the stream, were transported primarily in particulate form. Dissolved Mn, and to a lesser extent dissolved Zn, generally increased in concentration as streamflow increased during storms, while dissolved Cr and dissolved Pb generally decreased. Dissolved levels of Cu, Mn, Zn and Fe were correlated positively with dissolved organic carbon concentration, which frequently increased rapidly during early stormflow (i.e., indicating a flushing effect). Analysis of elements associated with stream particulate matter showed positive correlation between concentrations of several trace elements and Fe and Mn. The 12-month streamflow exports of Cd, Cr, Cu, Pb, Zn, Mn and Fe were respectively, 0.15, 0.49, 0.69, 2.22, 12.4, 193 and 316 grams/hectare.

40228 (N—76-26716) **Thermal radio emission of a contaminated sea surface.** Rayzer, V.Y.; Sharkov, Y.A.; Etkin, V.S. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij). May 1976. Translation of USSR report PR—237. (NASA-TT-F—17033; PR—237). 32p. NTIS $4.00.

Calculations are made of the radiative characteristics of water-film structures based on the thickness of the contaminating film and its temperature for various dielectric parameters of the contaminants, with allowance made for the formation of water-oil emulsions. Questions on the effective estimation of the thickness and dielectric parameters of films with the aid of remote UHF passive measurements of contaminated sea-surface areas are discussed. Calculations are compared with data from model experiments. (Author) (GRA)

40229 (PB—257734) **A limnological study of Spiritwood Lake, N.D., with special emphasis on its water quality, seasonal cycles of chemical nutrients, phytoplankton, zooplankton and primary production. Part I. Photosynthetic production and energy conversion in Spiritwood Lake, North Dakota.** Comita, G.W.; Wolf, E.G. (North Dakota Water Resources Research Inst., Fargo (USA)). Mar 1975. Contract DI-14-01-0001-882. 15p. (WI—222-006-75). NTIS $3.50.

See also PB—257735.

Gross integral production in Spiritwood Lake, North Dakota, measured by the light and dark bottle method from June 6 to September 7, 1966, was 111.1 cal per sq. cm for a solar radiation energy conversion efficiency of 0.36 per cwt. Estimates for the entire year yielded 159.2 cal per sq. cm and an efficiency of 0.19 per cwt. Integral phytoplankton respiration (June 6 through September 7) was 23.6 cal per sq. cm or 21.2% of integral gross production, from which a P-to-R ratio of 5.03 was calculated. Integral net phytoplankton production for the summer was 87.5 cal per sq. cm for an efficiency of 0.28%. This value for the entire year (8.3 months) was 121.3 cal per sq. cm or 0.20% of the available incident solar radiation. (GRA)

40230 (PB—256588) **AD HOC advisory panel on evaluated physical property data in aid of aqueous environmental problems. Report on meeting, August 14—15, 1975.** (National Research Council, Washington, D.C. (USA). Numerical Data Advisory Board). Aug 1975. 92p. NTIS $5.00.

Sponsored in part by National Bureau of Standards, Washington, D.C. Office of Standard Reference Data.

Report on an NAS-NRC Panel discussion of needs for evaluated physical and chemical property data of importance for environmental monitoring and effluent control, for the study of the fate of pollutants and for the establishment of meaningful standards. Systems include both organic and inorganic pollutants in solution and in the presence of particulate matter; properties include analytical, equilibrium, and surface properties. (GRA)

40231 (PB—255266) **Water quality inventory.** Cogger, W.J.; Payne, M.L.; Sprenger, L.D. (Environmental Protection Agency, Denver, Colo. (USA). Region VIII). Oct 1975. 248p. NTIS $8.00.

Water quality in Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming is discussed. Pollution from zinc, copper, lead, mercury, selenium, radium, barium, and cadmium is considered. Color illustrations reproduced in black and white. (GRA)

40232 **Impact of acid precipitation on freshwater ecosystems in Norway.** Wright, R.F.; Dale, T.; Gjessing, E.T.; Hendrey, G.R.; Henriksen, A.; Johannessen, M.; Muniz, I.P. (Norwegian Inst. for Water Research, Oslo). *Water, Air, Soil Pollut.;* **6**: No. 2/3/4, 483-499(1976).

Extensive studies of precipitation chemistry during the last 20 yr have clearly shown that highly polluted precipitation falls over large areas of Scandinavia, and that this pollution is increasing in severity and geographical extent. Precipitation in southern Norway, Sweden, and Finland contains large amounts of H^+, SO^-_4, and NO_3^- ions, along with heavy metals such as Cu, Zn, Cd, and Pb, that originate as air pollutants in the highly industrialized areas of Great Britain and central Europe and are transported over long distances to Scandinavia, where they are deposited in precipitation and dry-fallout. In Norway the acidification of fresh waters and accompanying decline and disappearance of fish populations were first reported in the 1920s, and since then in Sorlandet (southernmost Norway) the salmon have been eliminated from several rivers and hundreds of lakes have lost their fisheries. Large areas of western, southern, and eastern Norway have been adversely affected by acid precipitation. The pH of many lakes is below 5.0, and sulfate, rather than bicarbonate, is the major anion. Lakes in these areas are particularly vulnerable to acid precipitation because their watersheds are underlain by highly resistant bedrock with low Ca and Mg contents. Apart from the well-documented decline in fish populations, relatively little is known about the effects of acid precipitation on the biology of these aquatic ecosystems. Biological surveys indicate that low pH-values inhibit the decomposition of allochthonous organic matter, decrease the species number of phyto- and zooplankton and benthic invertebrates, and promote the growth of benthic mosses.

40233 **Acid precipitation and its influence upon aquatic ecosystems: an overview.** Gorham, E. (Univ. of Minnesota, Minneapolis). *Water, Air, Soil Pollut.;* **6**: No. 2/3/4, 457-481(1976).

The impact of acid precipitation reflects a usually deleterious balance between good and bad effects which may lead to serious and sometimes extreme degradation of aquatic as well as terrestrial ecosystems, particularly around metal smelters. Addition of H ions as H_2SO_4, HNO_3, and HCl can alter and impoverish the species composition of biotic communities, and lead to severe leaching of beneficial metal cations such as Ca from ecosystems. Heavy metals and other trace elements which accompany acid precipitation may reach toxic levels, particularly where acid fallout leaches additional amounts from the soil into streams and lakes. Complex and often toxic hydrocarbons also comprise a little known organic component of acid precipitation. Alternatively, acid precipitation usually is enriched in plant nutrients such as nitrate- and ammonia-nitrogen, K, Ca, and S; and at certain concentrations some of the associated trace elements may also be beneficial. Moreover the initial effect of soil leaching by acid fallout may be to enrich aquatic ecosystems in metal cations such as Ca. Basic materials in air pollution, biogenic NH_3 from the soil, dust fall from arid regions, and soils rich in adsorbed metal cations or in carbonates may neutralize some of the harmful effects of acid precipitation upon ecosystems. However, associated heavy metals, other trace elements, and toxic hydrocarbons may still constitute serious problems in many environments.

40234 (PB—257449) **Disinfection of wastewater. Task Force report.** (Environmental Protection Agency, Washington, D.C. (USA). Municipal Construction Div.). Mar 1976. 67p. (EPA—430/9-75/012; EPA/MCD—21). NTIS $4.50.

A Task Force Report has been prepared to provide a compilation of the existing technical and scientific data related to the issues raised by wastewater disinfection. The report is divided into four main parts--Summary, Conclusions and Recommendations; Public Health Effects and Considerations; Toxic Effects on the Aquatic Environment; and Disinfection Process Alternatives. Also included in the report is a summary of the Agency's ongoing research and development program in the area of wastewater disinfection and alternate means of disinfection. (GRA)

40235 (PB—258063) **Contaminant inputs to the New York Bight. Technical memo.** Mueller, J.A.; Jeris, J.S.; Anderson, A.R.; Hughes, C.F. (National Oceanic and Atmospheric Administration, Boulder, Colo. (USA). Marine Ecosystems Analysis Program Office). Apr 1976. 360p. (NOAA-TM-ERL-MESA—6). NTIS $10.50.

The report presents an estimate of the location and magnitude of contaminant inputs into the New York Bight, indicates their

relative importance, and identifies data gaps. Four sources of contaminant inputs were evaluated in the study: barge dumps and atmospheric fallout as direct bight inputs, and wastewater and runoff as coastal inputs to waters ultimately draining to the bight. The sources were further subdivided into their various constituents: dredge spoils, sewage sludge, acid wastes, chemical wastes and rubble for the barge dumps; gaged stream flow, urban runoff, and groundwater outflow for the runoff, and municipal and industrial wastewater inputs. (GRA)

40236 (PB—255794) Electrochemical production of free radicals for wastewater treatment. Completion report. Hemphill, L.; Clark, M. (Missouri Water Resources Research Center, Columbia (USA)). 20 May 1976. Contract DI-14-31-0001-4025. 34p. NTIS $4.00.

The purpose was to determine the nature and kinetics of aqueous free radical oxidation reactions produced by glow discharge electrolysis (GDE) and ^{60}Co gamma irradiation. Results showed that phenolic solutions and domestic wastewater were oxidized by GDE and gamma radiation produced free radicals. Direct comparison of the free radical oxidation produced by GDE and ^{60}Co gamma irradiation indicated organic oxidation was a first order reaction and GDE was more efficient. Comparison of chemical dosimetry (Fricke) results showed that a laboratory GDE reactor apparatus produced a radiation dose rate equivalent to about one third of the radiation dose rate of a kilocurie ^{60}Co source. Radiolysis decay of phenol solutions by ^{60}Co and GDE proceeded at a rate proportional to the chemical dosimeter (Fricke) determined values for each source. Design of GDE reactors and associated equipment is described. Domestic waste water GDE radiolysis is a typical first order reaction. (GRA)

40237 Situ experiments on the dissolved and colloidal state of iron in an acid bog lake. Koenings, J.P. (Univ. of Michigan, Ann Arbor). *Limnol. Oceanogr.;* **21**: No. 5, 674-683(Sep 1976).

A sampler and an analytical and characterization scheme were developed to investigate the chemical and physical state of iron in a highly stained acid bog lake (North Gate Lake). Iron fractions were chemically separated by reactivity to bathophenanthroline (BPN) after specific digestion procedures. Physical separation by anaerobic in situ filtration (450 nm) and in situ dialysis (4.8 nm) resulted in three size classes: particulate, colloidal, and dissolved. Inorganic, nonreactive species of iron [e.g., $Fe(OH)_3$] represent minor amounts of the total iron in North Gate Lake, in contrast to lakes of pH 6-8. In situ radiochemical analyses revealed that colloidal reactive ferric iron predominates in the oxygenated epilimnion, while dialyzable or dissolved ferrous iron increases with depth. Unlike iron, organic matter is present in a nontransient colloidal state. In acid (pH 4-5) bog lakes ferric iron may be colloidal not as an inorganic complex (OH^-) but as reactive Fe^{3+} by complexation with the colloidal organic acids. After thermally induced mixing with anaerobic waters, ferric iron is reduced and dissolved; however some of the BPN reactive iron remains colloidal, suggesting the presence of a residual ferrous organic complex.

40238 Influence of colloidal organic matter on iron and iron—phosphorus cycling in an acid bog lake. Koenings, J.P.; Hooper, F.F. (Univ. of Michigan, Ann Arbor). Contract AT(11-1)-1771. *Limnol. Oceanogr.;* **21**: No. 5, 684-696(Sep 1976).

The relationship between iron and phosphorus and the relationship of these elements to colloidal organic matter (COM) was studied in a meromictic acid bog lake by chemical characterization, filtration and in situ dialysis, and in situ experiments with labeled components. Bathophenanthroline (BPN) reactive ferrous iron existed in true solution (dialyzable) in constantly anaerobic monimolimnetic water; in the aerobic epilimnion reactive ferric iron was of colloidal size. Intermediate depths, oxygenated only during spring, contained two forms of ferrous iron reactive to BPN: dialyzable ferrous iron (Fe^{2+}) and colloidal Fe(II) which may have originated through in situ reduction of colloidal reactive ferric iron and may be present as a COM-Fe^{2+} complex. The amount of COM influenced the fate of dialyzable Fe^{2+} (92 percent of total iron) and dialyzable PO_4-P (85 percent of total phosphorus) present in anaerobic strata before aeration. Aeration with soluble organic matter present (COM absent) resulted in the formation of colloidal nonreactive ferric iron (84 percent of total iron) and 65 percent colloidal PO_4-P, while aeration with 26 mg liter^{-1} COM resulted in only 36 percent colloidal, nonreactive ferric iron and 19 percent colloidal PO_4-P. COM apparently masks the cationic properties of colloidal ferric iron and retards the formation of nonreactive Fe(III), allowing most of the PO_4-P to remain free in solution and biologically available.

40239 Role of methylmercury production in the transfer of mercury in a salt marsh ecosystem. Windom, H.; Gardner, W.; Stephens, J.; Taylor, F. (Skidaway Inst. of Oceanography, Savannah). *Estuarine Coastal Mar. Sci.;* **4**: No. 5, 579-583(Sep 1976).

A salt marsh estuary which has received large discharges of inorganic mercury for several years was studied to evaluate the occurrence and production of methylmercury. The methyl form was not detected (less than 1 ng/g) in marsh sediments or marsh vegetation (Spartina alterniflora). Significant concentrations were detected in the dominant primary consumers (Littorina irrorata and Uca sp.). Assuming these organisms accumulated a significant percentage of the methylmercury produced in the salt marsh ecosystem, its annual production there is estimated at about 50 μg/g of total mercury in the upper 5 cm of the sediment column.

40240 Accumulation and distribution of total mercury in estuarine sediments. Cranston, R.E. (Bedford Inst. of Oceanography, Dartmouth, Nova Scotia). *Estuarine Coastal Mar. Sci.;* **4**: No. 6, 695-700(Nov 1976).

The mercury concentrations found in sediment cores from an estuary display maximum values in an area where the salt-water influence on the river becomes significant. Statistical analyses indicate the mercury concentrations are associated with fine sediments located in a specific area within the estuary. This is interpreted to result from mercury adsorption on sedimenting particulate matter. Organic carbon concentrations reach their highest values in the same area, but do not correlate to a significant degree with the mercury data. The organic carbon concentrations appear to result from accumulation of vegetation debris and precipitation of dissolved organic matter. Mercury concentration gradients with depth in the sediment core are not evident. This is probably due to physical and biological mixing within the sedimentary environment.

40241 (PB—255937) Assessment of the impact of proposed thermal effluent guidelines for the steam electric power industry. (Teknekron, Inc., Berkeley, Calif. (USA)). 11 Nov 1976. Contract FEA-C-04-50041-00. 120p. (TK—75-0016). NTIS $5.50.

Possible impacts on the electrical utility industry of proposed water pollution control regulations are assessed. The report begins with an analysis of the Federal Water Pollution Control Amendments of 1972 and the proposed regulations affecting the steam electric power industry which EPA issued as part of the implementation of that Act. The analysis was concentrated most heavily upon the potential near-term fuel penalty associated with mandated dates for compliance and coverage of existing steam generating units. (GRA)

40242 Trace metals (As, Cd, Cu, Fe, and Zn) in Arctic cod, Boreogadus saida, and selected zooplankton from Strathcona Sound, northern Baffin Island. Bohn, A.; McElroy, R.O. (British Columbia Research, Vancouver). *J. Fish. Res. Board Can.;* **33**: No. 12, 2836-2840(Dec 1976).

Arctic cod (Boreogadus saida) were captured by bottom trawl at depths of 120 to 300 m. Zooplankton were obtained by bottom to surface tows from the Arctic cod habitat. Average concentrations of As and Zn were higher in Arctic cod fillets than in livers from the same fish; Cd and Fe concentrations were higher in livers. The difference between Cu concentrations in muscle and liver was not significant. As and Zn in whole fish, and As in fillets from seven specimens, were positively correlated to body weight. Cu and Fe in whole fish were negatively correlated to body weight, whereas Cd was not related to body weight. Examination of Arctic cod stomach contents indicated that planktonic copepods were important in the diet. Cd levels were 5 to 8 times higher in the unsorted copepods than in the Arctic cod, whereas As, Cu, Fe, and Zn were higher in the fish than in the copepods.

40243 Kinetic model and equilibrium relationship for heavy metal accumulation on activated sludge. Neufeld, R.D.; Gutierrez, J.; Novak, R.A. *J. Water Pollut. Control Fed.;* **49**: No. 3, 489-498(Mar 1977).

Upflow columnar laboratory studies, using a differential activated sludge bed, were designed to investigate the forward and reverse kinetics and ultimate equilibria for the removal of mercury and cadmium from aqueous chloride solutions in concentrations from 0.1 to 1000 mg/l. The differential bed consisted of a finite captive layer of biomass held in a 5-cm diameter reactor accommodated with glass wool at both ends, and gauze pad at the top end. Batch equilibrium information was obtained for other metals as well. Results show the following as saturation weight ratios of metal sorbed on sludge (g/g): Pb = 1.0, Cd = 0.275, Hg = 0.120, Cr(+3) = 0.0625, Cr(+6) = 0.025, Zn = 0.0154, Ni = 0.0075. These orders of magnitude agree with other investigations as reported in the literature.

40244 Identification of organic halogen products. Jolley, R.L. (Oak Ridge National Lab., TN). *Chesapeake Sci.;* **18**: No. 1, 122-125(Mar 1977).

Relatively little is known about organic halogen products in chlorinated estuarine or marine cooling waters. Extrapolation from those found in chlorinated fresh and polluted waters indicates that such compounds are probably formed. It is anticipated that these organic halogen products would include bromo-organic constituents. The paper describes the methodology used to examine wastewater effluents and freshwater cooling towers and some experimental results. These procedures may be adaptable to marine and estuarine cooling waters if the high saline concentrations of such waters can be circumvented. (CAJ)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 39317, 39353, 40194, 40196, 40197, 40198, 40199, 40200, 40201, 40202, 40203, 40492

40245 (ORNL-tr—4348) **Effect of sediment displacement on the dispersal of radionuclides.** Schaeffer, R. (Electricite de France, 75 - Paris). 1975. Translated by S.D. Blalock Jr. from pp 263-274 of STI/PUB—406. (CONF-750662—4). 12p. P 02/MF A01.

From Symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

The bulk of discharged radionuclides are adsorbed by the sediments in water courses. It follows from this that the volumetric activity of the water decreases with distance from the disposal point in an approximately exponential manner. However, the activity accumulated by the sediments deposited on the river bed does not follow this law: the bottom transport to which these sediments are subjected reverses the direction of the variation for them so that their activity increases progressively in the downstream direction, reaching a maximum which may be situated a great distance away after a long period of disposal. In the long term, therefore, the sediments could constitute the main source of irradiation of populations living on river banks fairly far from a disposal point. In view of this variation of sediment activity in time and in space, the paper draws attention to the fact that a very limited number of measurements repeated at a single point is not representative.

40246 (PB—255572) **Plutonium levels in the sediment of area impoundments environs of the Rocky Flats Plutonium Plant - Colorado.** Lammering, M.W. (Environmental Protection Agency, Denver, Colo. (USA)). Feb 1975. 51p. (EPA—908/2-75/001; SA/TIB—29). NTIS $4.50.

Plutonium concentrations in the bed sediment of reservoirs (Great Western Reservoir, Standley Lake, Cherry Creek Reservoir, Marston Lake, and Ralston Reservoir) in the environs of the Atomic Energy Commission Rocky Flats Plant were determined by dredge and core sampling. Great Western Reservoir and Standley Lake were sampled during October, 1973; the other three impoundments during April, 1974. The baseline level of plutonium-239 in bed sediment attributable to worldwide fallout was found to be < or = 0.10 pCi/gram (dry weight). Correspondingly, the maximum concentrations in the top layer of sediment in Great Western Reservoir were approximately 4.0 pCi/gram (dry weight). The thickness of the layer of plutonium-contaminated sediment in the reservoir was 5 cm or more at most sampling stations. Through 1973, Great Western Reservoir received liquid wastes (plutonium-bearing) from the Rocky Flats Plant via the tributary stream, Walnut Creek. (GRA)

40247 **Biological pathways and chemical behavior of plutonium and other actinides in the environment.** Dahlman, R.C.; Bondietti, E.A.; Eyman, L.D. (Oak Ridge National Lab., TN). *ACS Symp. Ser.;* **35**: 47-80(1976).

The principal long-lived actinide elements that may enter the environment from either U or Pu fuel cycles are Pu, Am, Cm, and Np. Approximately 25% of the alpha activity estimated to be released to the atmosphere from the LMFBR fuel cycle will be contributed by ^{241}Am, ^{242}Cm, and ^{244}Cm. The balance of the alpha activity will come from Pu isotopes. Activities of ^{242}Cm, ^{244}Cm, ^{241}Am, ^{243}Am, and ^{237}Np in waste may exceed concentrations of Pu isotopes in waste after various periods of decay. Thorium and uranium isotopes may also be released by operations of the thorium fuel cycle. Environmental actinides are discussed under the following headings: sources of man-made actinide elements; pathways of exposure; environmental chemistry of actinides; uptake of actinides by plants; distribution of actinides in components of White Oak Lake; entry of actinides into terrestrial food chains; relationship between chemical behavior and uptake of actinides by organisms; and behavior of Pu in freshwater and marine food chains. (HLW)

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 40241, 40457

40248 (PB—256939) **Remote sensing study of steam-electric power plant thermal discharges to Lake Erie, Detroit and St. Clair Rivers, Ohio and Michigan.** (National Field Investigations Center-Denver, Colo. (USA); Environmental Protection Agency, Chicago, Ill. (USA). Region V). Mar 1974. 98p. NTIS $5.00.

Prepared in cooperation with Environmental Protection Agency, Chicago, Ill. Region V.

An airborne remote sensing study of thermal discharges to Lake Erie and the Detroit and St. Clair Rivers was conducted on 9 July 1973. The study area encompassed the southern shore of Lake Erie from about 5 km (3 mi) east of Ashtabula, Ohio, to Toledo (Maumee Bay), Ohio, and the western shore of Lake Erie from Toledo to the mouth of the Detroit River. The western shores of the Detroit and St. Clair Rivers were also included in the study area. Thermal infrared imagery of the entire study area was obtained using infrared line scanners mounted in high performance reconnaissance aircraft. Ground measurements of water temperatures were made at most of the power plants. This imagery and the ground truth water temperature data were used to characterize the observed thermal fields or plumes. (GRA)

40249 (PB—255727) **Cooling water discharge research project. Final report.** Jenson, L.D.; Geyer, J. (Ecological Analysts, Inc., Baltimore, Md. (USA); Johns Hopkins Univ., Baltimore, Md. (USA). Dept. of Geography and Environmental Engineering). Jul 1976. 68p. NTIS $4.50.

Prepared in cooperation with Johns Hopkins Univ., Baltimore, Md. Dept. of Geography and Environmental Engineering.

From the outset the objective of Project RP 49 was to help the electric power industry evaluate the kinds and extents of effects which the discharge of condenser cooling water may have on ponds, rivers, lakes and estuaries used for once-through cooling. Under the initial project it was proposed: (1) to summarize existing knowledge, (2) to apply this knowledge in the development of useful analytical techniques, (3) to determine the kinds of additional information that will be needed, and (4) to suggest how the industry might undertake to acquire the needed information. Field studies were also undertaken to determine the numerical value of cooling coefficients needed. (GRA)

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 39553, 39658, 40217

REGULATIONS

REFER ALSO TO CITATION(S) 40204

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 39668, 39724, 40218, 40220

40250 (ORNL/RUS—26) **Reflections on Regional Environmental Systems Analysis.** Craven, C.W. Jr.; Olsen, R.J.; Reichle, D.E.; Schuller, C.R.; Voelker, A.H. (Oak Ridge National Lab., Tenn. (USA)). Mar 1977. Contract W-7405-ENG-26;NSF-INA-AAA-R-4-79. 84p. P 05/MF A01.

The purpose of the Regional Environmental Systems Analysis (RESA) Program is to develop and communicate to the planning and management community an improved basis for forecasting the environmental impacts of public and private decisions (such as land use) in order to improve environmental and energy resource management. The research strategy was to develop and validate a hierarchy of computer models to assist in the analysis of relevant economic, physical, ecological, and social processes in a 16-county region of east Tennessee. Although the principal focus of the work is on a 6500-square-mile region in eastern Tennessee, the approach is designed to be applicable to other regions. 406 references.

40251 **Responses of industry within Aberdeen to oil related change: some implications for urban planners.** Hunt, D. (Inst. of Tech., Aberdeen, Eng.). *Int. J. Environ. Stud.;* **9**: No. 4, 269-278(1976).

Remaining oil reserves are predominately located offshore. Development of such resources will be accompanied by the growth of onshore supply centers. Location of such centers will depend on possession of an airport and twenty-four hour port facilities. Aberdeen has recently experienced and responded to such oil related development. The pattern of impact evidenced there may well contain interesting pointers for other areas, particularly within mature economies which are about to be transformed by oil related industrial activity.

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 39452, 39453, 39655, 39658, 39659

BIOMEDICAL SCIENCES, BASIC STUDIES

40252 **Ecosystem persistence and heterotrophic regulation.** O'Neill, R.V. (Oak Ridge National Lab., TN). *Ecology;* **57**: No. 6, 1244-1253(Aut 1976).

Mechanisms leading to ecosystem persistance are explored with a simple mathematical conceptualization. The concept is quantified for six ecosystems ranging from tundra to tropics and including both terrestrial and aquatic systems. Deductions from the concept are compared with predictions from the theory of power as a basic parameter of system function. Analysis of the equations indicates that heterotrophs in the ecosystem may be capable of exerting effective control by changes in biomass that would be difficult to detect in field sampling. The effectiveness of the control is influenced by significant differences in turnover rates among ecosystem components. It is suggested that simple mathematical constructs, quantifiable from available data and amenable to direct analysis, have much to offer in increasing our understanding of ecosystem function.

BEHAVIORAL BIOLOGY

40253 **Tissue correlations in linear samples.** Percus, J.K. (Univ. of New York, NY). *J. Theor. Biol.;* **577**: 281-299(1976).

A line sample is made through an aggregate of many tissue types. The question treated is whether the observed distribution of heterotype contacts is consistent with a random placement of the tissues. A generating function in the form of a weighted Markov chain is set up and analyzed for various assumptions as to a priori probabilities. The case in which all tissue types but the pair being assayed are combined in a communal tissue is solved explicitly in the limit of a large sample. Corrections due to finite sample size and to the detailed structure of the communal tissue are carried out.

40254 **Postnatal growth and development of captive Franklin's ground squirrels (Spermophilus franklinii).** Turner, B.N.; Iverson, S.L.; Severson, K.L. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). *Am. Midl. Nat.;* **95**: No. 1, 93-102(Jan 1976).

Growth and development of Franklin's ground squirrels (Spermophilus franklinii) were determined from 87 young, raised by wild-caught females in the laboratory. Developmental stages appeared in the same sequence, but at a mean earlier age than in any other species of Spermophilus except S. undulatus. Lower incisors erupted on day 7, eyes and ears opened on day 20, and weaning occurred by day 28. Weight reached 25 percent of adult weight by day 34, 50 percent by day 44, 75 percent by day 54, and adult weight was reached by day 65. The instantaneous growth rate (IGR) was greatest in the 1st 10 days, with a maximum of 12.4 percent per day at day 3, decreasing to 1.2 percent by day 50. Hind foot length reached 75 percent of adult size by day 30, whereas total and tail lengths were less than 60 percent at the same age. Individual weight was negatively correlated with litter size, and there were indications of lower survival to weaning in numerically larger litters. Laboratory growth measurements cannot be directly extrapolated to field populations, since weaned laboratory young gained weight significantly more rapidly than field young. Data from similar studies on other hibernating sciurids suggest that birth dates and IGRs are related, and indicate a biological response to differing climates.

40255 **Effect of transmission-line corridors on bird populations.** Anderson, S.H.; Mann, K.; Shugart, H.H. Jr. (Oak Ridge National Lab., TN). *Am. Midl. Nat.;* **97**: No. 1, 216-221(Jan 1977).

Observations of bird populations were made along transmission-line corridors of four different widths (12, 30.5, 61, 91.5 m) in areas in which the transmission-line rights-of-way traversed typical eastern Tennessee deciduous forest. In addition, detailed grid-mapping of individual birds was conducted in forest and in a 30.5 m-wide corridor habitat. Narrow corridors (12 m) had reduced bird species diversity, but the 30.5 m corridor had high bird density and diversity. The wider corridors were less diverse but attracted several open-country bird species not characteristic of surrounding forest. Significance of the effects of the 30.5 m corridor on the distribution of 35 bird species was determined. The highest species diversity was associated with the forest habitat.

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 40101, 40320, 40321, 40322, 40323, 40346

40256 (BNL—50453, pp IV.49-IV.60) **Electromagnetic and neutron scattering from the 50 S subparticle of E. coli ribosomes.** Serdyuk, I.N. (Inst. of Protein Research, Moscow). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

It has been suggested that the component with a higher electron density (RNA) is on the average located nearer the center of the 50 S subparticle than the components with lower densities (proteins). The difference found in the compactness of RNA and protein between viruses and phages on one hand and ribosomes on the other reflects a different biological function of RNA in these particles.

40257 (BNL—50453, pp IV.60-IV.77) **X-ray and neutron small-angle scattering studies of human serum lipoproteins.** Luzzati, V. (Centre National de la Recherche Scientifique, Gif-sur-Yvette, France); Tardieu, A.; Mateu, L.; Sardet, C.; Stuhrmann, H.B.; Aggerbeck, L.; Scanu, A.M. 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

The paper describes an extended x-ray study of two types of human serum lipoproteins and a neutron study of one of them. The results are similar and to some extent complementary. Serum lipoproteins provide an excellent illustration of the wealth of information that can be obtained by a small-angle scattering approach to the structure of particles with non-uniform density distribution, by using solvents of variable density.

40258 (BNL—50453, pp IV.78-IV.96) **Scattering of neutrons by catalase: a study of molecules, subunits, and tubules.** Randall, J. (Univ. of Edinburgh); Starling, D.; Baldwin, J.P.; Ibel, K. 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

The paper deals with small-angle scattering of neutrons by catalase tetramers, dimers, and monomers and with neutron diffraction by helical assemblies of tetramers in the form of tubules. A preliminary study of catalase is described.

40259 (BNL—50453, pp IV.97-IV.117) **Neutron-scattering studies of chromatin.** Bradbury, E.M. (Portsmouth Polytechnic, Eng.); Baldwin, J.P.; Carpenter, B.G.; Hjelm, R.P.; Hancock, R.; Ibel, K. 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

It is clear that a knowledge of the basic molecular structure of chromatin is a prerequisite for any progress toward an understanding of chromosome organization. With a two-component system, protein and nucleic acid, neutrons have a particularly powerful application to studies of the spatial arrangements of these components because of the ability, by contrast matching with H_2O-D_2O mixtures, to obtain neutron-scattering data on the individual components. With this approach it has been shown that the neutron diffraction of chromatin is consistent with a "beads on a string" model in which the bead consists of a protein core with DNA coiled on the outside. However, because chromatin is a gel and gives limited structural data, confirmation of such a model requires extension of the neutron studies by deuteration of specific chromatin components and the isolation of chromatin subunits. Although these studies are not complete, the neutron results so far obtained support the subunit model described above.

40260 (BNL—50453, pp V.3-V.11) **Synthesis of partially deuterated cholesterol.** Larsen, D.L.; Grist, K.L. (Brookhaven National Lab., Upton, NY). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

The ability to synthesize analogs of small, naturally occurring molecules in which all or some of the protons have been replaced by deuterium atoms could be of great importance in elucidating the structures of certain biological entities by neutron diffraction analysis. The report deals with the synthesis of cholesterol with specific substitution of deuterium for hydrogen in the alkyl "tail."

40261 (BNL—50453, pp V.12-V.23) **Production of deuterated E. coli.** Moore, P.B.; Engleman, D.M. (Yale Univ. New Haven). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

Many informative neutron-scattering experiments can be done on macromolecules provided specimens can be prepared that are appropriately deuterated in nonexchangeable positions. Since the only general method of preparation is incorporation in vivo, the first task in doing such experiments is to find conditions under which the relevant organisms will incorporate deuterium into macromolecules. The purpose of the paper is to outline the experience in growing one such organism, the bacterium E. coli, in the presence of deuterium. Data (and opinions) are offered as a guide to those who might want to undertake neutron experiments based on deuteration.

40262 (BNL—50453, pp VI.3/VI.26) **Inelastic neutron scattering from synthetic and biological polymers.** White, J.W. (Oxford Univ.). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

Neutron elastic and inelastic scattering measurements have provided many unique insights into structure, and by reviewing progress on synthetics, important differences likely to arise in biological systems are identified and a direction for studies of the latter is suggested. By neutron inelastic scattering it is possible to measure the frequency of thermally excited interatomic and intermolecular vibrations in crystals. With perfect organic and inorganic crystals the technique is now classical and has given great insight into the crystal forces responsible for the observed structures as well as the phase transitions they undergo. The study of polymer crystals immediately presents two problems of disorder: (1) Macroscopic disorder arises because the sample is a mixture of amorphous and crystalline fractions, and it may be acute enough to inhibit growth of a single crystal large enough for neutron studies. (2) Microscopic disorder in the packing of polymer chains in the "crystalline" regions is indicated by broadening of Bragg peaks. Both types of disorder problem arise in biological systems. The methods by which they were partially overcome to allow neutron measurements with synthetic polymers are described but first a classical example of the determination of interatomic forces by inelastic neutron scattering is given.

40263 (BNL—50453, pp VI.27-VI.36) **Dynamics of polypeptide chains.** Peticolas, W.L. (Univ. of Oregon, Eugene). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

In the paper the concepts necessary for understanding the vibrations of ordered linear polypeptide chains are briefly reviewed, and some results of work at the Institute Laue-Langevin on poly-L-alanine are presented.

40264 (BNL—50453, pp VII.3-VII.29) **Investigation of biological macromolecular systems with a pulsed neutron source: a review.** Cser, L. (Joint Inst. for Nuclear Research, Dubna, USSR). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

The investigation of biological macromolecules and crystalline structures by SAS and diffraction of neutrons with the TOF method indicates that the main difficulties of the TOF method (the wavelength dependence of the incident beam, resolution power, and detector efficiency; the need for their determination and up-to-date values) are compensated for by its advantages. Both methods allow a high data accumulation rate and optimal employment of the incident neutron spectrum. The latter has been achieved by utilizing a dominant part of the Maxwellian spectrum and by a more uniform distribution of statistical accuracy over the most informative measuring range. Another advantage is the high degree of monochromatization of the incident neutron beam by the TOF method. The rigid requirements concerning the data accumulation rate and the capacity of the on-line system computer memory are technical problems but not basic ones.

40265 (BNL—50453, pp VII.30-VII.48) **Multilayer monochromators for neutron scattering.** Saxena, A.M.; Schoenborn, B.P. (Brookhaven National Lab., Upton, NY). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

In an earlier paper Schoenborn et al. reported the fabrication of thin-film monochromators for neutrons. They showed that a multilayer consisting of alternating films of two materials acts as a good monochromator with large and adjustable periodicity and wide bandwidth. The technique of making these multilayers has been modified with a resultant improvement in their reflectivity and diffraction properties. A detailed study of the multilayers has shown that they can be used as monochromators with unique properties. The reflectivities of such monochromators are comparable with those of pyrolytic graphite crystals, and they have low high-order contamination. The multilayers may also be used as efficient polarizers and filters of neutrons. Both kinematical and dynamical approaches have been developed in order to understand the diffraction properties of these multilayers. The influence of some aperiodicity on the diffraction data has also been introduced within the framework of kinematical theory.

40266 (BNL—50453, pp VII.49-VII.56) **Some focusing techniques and their application to low-angle neutron scattering.** Nunes, A.C.; Zaccai, G. (Brookhaven National Lab., Upton, NY). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

Both imaging and simple converging collimator systems can provide a focused neutron beam. Each system has been tested and appears suitable for exploitation. Imaging systems employing bent multilayer monochromators can be made simply by elastically bending a flat multilayer. The periodic spacing of the multilayer can be made to match that of the sample. The converging Soller slit provides a purely geometric means of producing a focused beam. Wavelength spread and distribution across the beam can be controlled separately. Soller-slit technology is further advanced than that of multilayers. The experiments demonstrate that converging or focused neutron beams suitable for low-angle scattering work can be produced with existing technology. Focusing incurs little or no loss of intensity and does not seriously distort the resolution function of a low-angle instrument. It permits a small spectrometer to make use of both advanced detector technology and large samples and thus to approach the capability of a much larger machine.

40267 (BNL—50453, pp VII.57-VII.66) **Analyzer in neutron protein crystallography.** Nunes, A.C.; Norvell, J.C. (Brookhaven National Lab., Upton, NY). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

Use of a pyrolytic graphite analyzer in an elastic scattering experiment and a description of the experiences is described. Using the analyzer contributes to the cleanliness of a neutron protein crystallographic study. If neutrons of approximately 1.5-A wavelength are used, higher orders are reduced by nearly an order of magnitude, and background (arising largely from incoherent inelastic neutron-proton scattering) is reduced by nearly a factor of five. These advantages are gained at the expense of approximately 50 percent of measured integrated intensity and a distortion of integrated intensity with scattering angle. Because background scatter is generally large compared with peak reflectivity of a protein, the large background reduction by the analyzer more than compensates for reduced peak intensity to improve the statistics of most peak reflectivity measurements. The luminance function distortion of intensity data is not large, produces a slight smearing of atomic scattering density, and can be calculated and adjusted for in the data.

40268 (BNL—50453, pp VII.67-VII.76) **Short introduction to resolution errors in solution scattering data.** Moore, P.B. (Yale Univ., New Haven). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

Some of the systematic errors of solution scattering data and the remedies available are discussed. The paper defines the problem, provides a general notion of how it is approached, and shows a few examples of how these errors affect neutron solution scattering profiles and what recovery procedures can do to correct them.

40269 (BNL—50453, pp VII.77-VII.106) **Data analysis of low-angle diffraction by one-dimensional crystals.** Yeager, M.J. (Yale Univ., New Haven). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

One Fourier synthesis has three potential sources of error: errors in phases, errors in the structure-factor amplitudes, and series termination errors. The paper discusses the last two sources of error, with emphasis on the treatment of errors in determining the structure-factor amplitudes.

40270 (BNL—50453, pp VII.107-VII.125) **Dynamical effect in small-angle neutron diffraction from membranes.** Caspar, D.L.D.; Phillips, W.C. (Brandeis Univ., Waltham, MA). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

It has been suggested that multilayers with large repeat periods, fabricated by evaporating alternating thin films of two metals with high scattering-density contrast, could be used as efficient wide-band pass monochromators for x-rays and neutrons. In the limit of a large number of weakly reflecting, periodically arranged layers, the analysis gives results corresponding to those of the dynamical theory for diffraction of x-rays and neutrons from perfect crystals. Measurement of dynamical neutron diffraction effects from

membrane arrays provides significant information about the order in the packing and the absolute scattering-density difference between layers.

40271 (BNL—50453) **Neutron scattering for the analysis of biological structures. Brookhaven symposia in biology. Number 27.** Schoenborn, B.P. (ed.). (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. Contract E(30-1)-16. 424p. (CONF-750629—). Dep. NTIS $13.50.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

Sessions were included on neutron scattering and biological structure analysis, protein crystallography, neutron scattering from oriented systems, solution scattering, preparation of deuterated specimens, inelastic scattering, data analysis, experimental techniques, and instrumentation. Separate entries were made for the individual papers.

40272 (BNL—50453, pp I.3-I.9) **Structure and function in biology.** Hirs, C.H.W. (Indiana Univ., Bloomington). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

A summary is given of the history of the developments of structural chemistry in biology beginning with the work of the bacteriologist Ehrlich leading to a comprehensive examination of the influence of size and configuration on the interaction between specific antibodies and side-chain determinants. Recent developments include the recognition of a higher order of specificity in the interaction of proteins with one another.

40273 (BNL—50453, pp I.10-I.17) **Advantages of neutron scattering for biological structure analysis.** Schoenborn, B.P. (Brookhaven National Lab., Upton, NY). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

The papers demonstrate the successful use of neutron-scattering techniques to solve many different structural problems. The rapid advancement in this field has been due in part to the ingenious use of old experimental techniques and in part to the development of new ones, particularly those using two-dimensional counters. Most present experiments are, however, still hindered somewhat by the relatively low flux of present-day neutron sources. Little direct increase in reactor flux can be expected, but the flux can often be improved by providing radiation at the optimal wavelength lambda for the resolution required through the use of either hot or cold moderators to maximize flux. Improvements in beam geometry brought about by efficient monochromators with a proper Δlambda and the use of focusing devices also serve to improve the effective flux. Further significant gain can be achieved in the future by the development of still larger high efficiency and high resolution two-dimensional counters.

40274 (BNL—50453, pp I.18-I.25) **Introduction to the theory of elastic neutron scattering.** Blume, M. (Brookhaven National Lab., Upton, NY). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

A theoretical comparison is made of the experimental techniques used in slow neutron scattering from solids and liquids and those of x-ray scattering, in order to see the similarities and the differences in the information they provide about the structure of matter.

40275 (BNL—50453, pp I.26-I.39) **Inelastic scattering of neutrons and possible biological applications.** Egelstaff, P.A. (Univ. of Guelph, Ontario). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

The field of neutron inelastic scattering has been developed to the stage where it can begin to help the biologist. Because essentially no experimental data have been obtained, it is difficult either to draw conclusions or to make forecasts except on the basis of general hypotheses. It seems likely, however, that the next stage is up to biologists. After reviewing those biological problems in which molecular dynamics might play an important role, they should suggest specimens of interest which can give inelastic peaks with existing spectrometers operating with 5 and 10-A neutrons at angles greater than 5° and with resolutions of approximately 50 μeV. These specimens may involve molecules slightly smaller and more mobile than some biologists would like, but a successful outcome might lead to the development of spectrometers capable of working in a more satisfactory range. In this event the return may well prove rewarding to the biologists.

40276 (BNL—50453, pp II.3-II.11) **Neutron diffraction analysis of metmyoglobin.** Schoenborn, B.P.; Diamond, R. (Brookhaven National Lab., Upton, NY). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

A neutron diffraction analysis was made of myoglobin to determine bound water, hydrogen-bonding, and the role of hydrogen in the binding of oxygen, water, and carbon monoxide to the heme group. A description is given of alterations of the real-space program and refinement of the met myoglobin structure.

40277 (BNL—50453, pp II.12-II.23) **Structure of carbon monoxide myoglobin: real-space refinement.** Norvell, J.C.; Schoenborn, B.P. (Brookhaven National Lab., Upton, NY). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

A crystallographic refinement was made of neutron diffraction data utilizing the real-space and model-building programs. The paper describes the refinement of the carbon monoxide myoglobin (CO-Mb) structure, and compares it with the met myoglobin structure. Results show the iron atom moves nearly into the heme plane. No deuterium atom exists to bond the distal histidine to the CO ligand.

40278 (BNL—50453, pp II.24-II.30) **Use of the tangent formula for the refinement of neutron protein data.** Norvell, J.C.; Schoenborn, B.P. (Brookhaven National Lab., Upton, NY). 1976.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

In Neutron scattering for the analysis of biological structures.

The tangent formula is considered as a computational technique that will lead to an improved set of phases in neutron protein crystallography. Results show that it works marginally for protein neutron data, at least to the extent that the images of all atoms except hydrogen are sharpened. However, the process is very sensitive to over-refinement, and all the maps were sharpened excessively. Refinements in the squared structure were more stable, and the maps were somewhat better than those from the original structure refinement. This technique might be helpful in certain instances, but the poor quality of the maps prevents it from being generally useful. The tangent refinement technique may be more fruitful in application to neutron protein data when experimental phase information is available.

40279 **Affinity labeling of a previously undetected essential Lysyl residue in class I fructose bisphosphate aldolase.** Hartman, F.C.; Brown, J.P. (Oak Ridge National Lab., TN). *J. Biol. Chem.;* **251**: No. 10, 3057-3062(25 May 1970).

The affinity label N-bromoacetylethanolamine phosphate (BrAcNHEtOP) has been used previously at pH 6.5 to identify His-359 of rabbit muscle aldolase as an active site residue. We now find that the specificity of the reagent is pH-dependent. At pH 8.5, alkylation with ^{14}C-labeled BrAcNHEtOP abolishes both fructose-1,6-P_2 cleavage activity and transaldolase activity. The stoichiometry of incorporation, the kinetics of inactivation, and the protection against inactivation afforded by a competitive inhibitor or dihydroxyacetone phosphate are consistent with the involvement of an active site residue. A comparison of ^{14}C profiles obtained from chromatography on the amino acid analyzer of acid hydrolysates of inactivated and protected samples reveals that inactivation results from the alkylation of lysyl residues. The major peptide in tryptic digests of the inactivated enzyme has been isolated. Based on its amino acid composition and the known sequence of aldolase, Lys-146 is the residue preferentially alkylated by the reagent. Aldolase modified at His-359 is still subject to alkylation of lysine; thus Lys-146 and His-359 are not mutually exclusive sites. However, aldolase modified at Lys-146 is not subject to alkylation of histidine. One explanation of these observations is that modification of Lys-146 abolishes the binding capacity of aldolase for substrates and substrate analogs (BrAcNHEtOP), whereas modification of His-359 does not. Consistent with this explanation is the ability of aldolase modified at His-359 to form a Schiff base with substrate and the inability of aldolase modified at Lys-146 to do so. Therefore, Lys-146 could be one of the cationic groups that functions in electrostatic binding of the substrate's phosphate groups.

40280 **Molecular size of the RNA genome of Pseudomonas aeruginosa bacteriophage PP7.** Benike, A.; McClements, W.; Davies, J.W. (Univ. of Wisconsin, Madison). *Virology;* **66**: 625-628(1975).

The molecular size of Pseudomonas aeruginosa bacteriophage PP7 RNA has been estimated by electron microscopy and polyacrylamide gel electrophoresis. The length of the genome is estimated to be 1.16 μm, similar to R17 RNA (1.22 μm). After formaldehyde treatment under conditions in which R17 RNA has an estimated molecular weight of 1.3 x 10^6, the molecular weight of the PP7 genome is 1.24 x 10^6. Without formaldehyde treatment, under conditions in which R17 RNA has an apparent molecular weight of 1.1 x

10^6, PP7 RNA molecular weight is calculated as 1.03×10^6. PP7 RNA is, therefore, a very similar size to Group I Escherichia coli RNA bacteriophage genomes, being only 6 percent smaller than R17 RNA, but about 20 percent smaller than Group III Qβ RNA. This molecular size is consistent with the suggestion that the PP7 genome has only three cistrons.

40281 Renilla luciferin as the substrate for calcium induced photoprotein bioluminescence. Assignment of luciferin tautomers in Aequorin and Mnemiopsin. Hori, K.; Anderson, J.M.; Ward, W.W.; Cormier, M.J. (Univ. of Georgia, Athens). *Biochemistry;* **14**: No. 11, 2371-2376(1975).

A study was made of the effects of pH and protic and aprotic solvents on the spectral properties of Renilla (sea pansy) luciferin and a number of its analogs. The results have made possible the assignment of two tautomeric forms of Renilla luciferin, one which absorbs maximally at 435 nm and another which exhibits an absorption maximum at 454 nm. Furthermore the results provide an explanation for the visible absorption characteristics of the photoproteins aequorin (lambda/sub max/ 454 nm) and mnemiopsin (lambda/sub max/ 435 nm). In addition a Renilla-like luciferin can be extracted from both of these photoproteins. This luciferin produces light with Renilla luciferase, at a rate dependent upon the concentration of dissolved oxygen, and in other respects is indistinguishable from Renilla luciferin in this bioluminescent reaction. The results suggest that the native chromophore in both photoproteins is Renilla luciferin (or a nearly identical derivative). The results also suggest that a hydroperoxide intermediate probably exists in photoproteins, on energetic grounds, and to account for the oxygen concentration independency of the rate of photoprotein reactions. This hydroperoxide may be attached initially to an amino acid side chain (possibly indolyl-OOH, imidazoyl-OOH, or -SOOH) rather than to the luciferin chromophore.

40282 Incorporation of thymidine and iododeoxyuridine into the DNA of mouse tissues. Myers, D.K.; Feinendegen, L.E. (Kernforschungsanlage, Juelich, Ger.). *Can. J. Physiol. Pharmacol.;* **53**: No. 6, 1014-1022(1975).

Mice were injected intravenously with a solution containing tritiated thymidine (TdR) and iodine-labelled iododeoxyuridine (IUdR). The ratio of $^3H/^{125}I$ activities was measured in the acid-soluble fraction and in the DNA of several tissues at various times from 0.08 to 24 h after injection. There did not appear to be any discrimination in favor of TdR in the acid-soluble fraction of the tissues. The amount of TdR incorporated into the DNA was four to five times greater than the amount of IUdR incorporated; moreover, this value remained relatively constant throughout the period of DNA synthesis under the conditions used. Although IUdR was destroyed more rapidly than TdR in the body, particularly at high concentrations of both precursors, this factor did not account for the major portion of the discrimination observed with tracer amounts of the two DNA precursors. Discrimination in favor of TdR as a precursor for DNA must, therefore, occur at some stage in the utilization of intracellular precursor.

40283 Measurement of chemically-induced DNA repair synthesis in human cells by BND-cellulose chromatography. Scudiero, D.; Henderson, E.; Norin, A.; Strauss, B. (Univ. of Chicago). *Mutat. Res.;* **29**: 473-488(1975).

Repair synthesis in human cells in tissue culture can be readily separated from semi-conservative DNA synthesis with the aid of a benzoylated naphthoylated DEAE cellulose (BND-cellulose) column. Cells are incubated with a radioactive DNA precursor during treatment with a repair-inducing agent. An inhibitor of semi-conservative DNA synthesis (hydroxyurea) is added to slow the progression of the DNA growing point. The cells are lysed and after treatment with ribonuclease and pronase the lysates are sheared and passed through a BND-cellulose column. Native DNA is eluted with 1 M NaCl. Any increase in radioactivity in the native DNA is due to repair synthesis and the specific repair activity (nucleotides inserted per μg of DNA) can be determined from radioactivity and absorbancy measurements. Repair can also be measured in the region of the DNA growing point by fractionation of the material eluted from BND-cellulose with 50 percent formamide. Repair was not detected in N-acetoxy-2-acetylaminofluorene (AAAF)-treated lymphoblasts derived from an individual with xeroderma pigmentosum although methyl methanesulfonate (MMS)-induced repair was observed in these cells.

40284 Importance of the stereochemical position of the 24-hydroxyl to biological activity of 24-hydroxyvitamin D_3. Tanaka, Y.; Frank, H.; DeLuca, H.F.; Koizumi, N.; Ikekawa, N. (Univ. of Wisconsin, Madison). *Biochemistry;* **14**: No. 15, 3293-3295(1975).

Both stereoisomers of 24-hydroxyvitamin D_3, i.e., 24(S)-hydroxyvitamin D_3 and 24(R)-hydroxyvitamin D_3, stimulate intestinal calcium transport almost equally well in the rat. The duration of effect is somewhat shorter for the 24(S)-hydroxyvitamin D_3 than for the 24(R)-hydroxyvitamin D_3. However, the 24(S)-hydroxyvitamin D_3 has little or no activity in the mobilization of calcium from bone, in the growth of rats on a low calcium diet, in the elevation of serum phosphorus of rachitic rats, or in the calcification of bone. On the other hand, the 24(R)-hydroxyvitamin D_3 is almost as active as 25-hydroxyvitamin D_3 in all of these systems, although its activity is not always of equal duration to that of 25-hydroxyvitamin D_3. The selectivity of these systems for only one of the 24-hydroxy stereoisomers supports the idea that in vivo 24-hydroxylation of vitamin D compounds is of functional importance.

40285 Observations on Levitt's 'new theory of transport'. Solomon, A.K.; Milgram, J.; Kirkwood, D.H. (Harvard Medical School, Boston). *Biochim. Biophys. Acta;* **406**: 157-160(1975).

Levitt has recently developed a new theory of transport for cell membrane pores based on the supposition that equivalent pores in the red cell membrane are so small that water and small solute molecules such as urea can not pass each other. Levitt's concept is based on the implicit assumption that urea and water are spherical molecules. We have shown, using a scale model, that Levitt's supposition is not in agreement with the actual molecular shapes. Levitt has further asserted that there is a serious methodological error in measurements reported fifteen years ago by Goldstein and Solomon. We have shown that the supposed methodological error lies in the fact that Levitt made his mathematical analysis of the appropriate equations under conditions significantly different from those employed by Goldstein and Solomon. A computer solution of the equations under the actual conditions used shows that Levitt's assertion is not justified.

40286 Carcinogenesis. Calvin, M. (Univ. of California, Berkeley). *Naturwissenschaften;* **62**: 405-413(1975).

The first step in the generation of a malignancy seems to be a transformation in the genetic apparatus of a single cell. The ultimate nature of the cancer which appears is a result of the interaction of that change with the control and regulatory apparatus of the whole animal. It appears that the primary cellular change which may be induced by physical, chemical or biological agents, or a combination of them, may be something which is common to all carcinogenesis. The nature of that primary change and how it may result from the action of viruses, chemicals and radiation, or interactions between them is the subject of this essay.

40287 Control of proliferation in mitogen responsive human peripheral blood lymphocytes: restimulation of cells stimulated by sodium periodate. Norin, A.J.; Strauss, B.S. (Univ. of Chicago). *J. Immunol.;* **114**: No. 6, 1683-1687(Jun 1975).

Human peripheral blood lymphocytes are stimulated to a greater extent by sodium periodate when cells are incubated in medium containing human serum than when incubated in medium with fetal calf serum. $NaIO_4$ stimulation can be reversed by treatment with sodium borohydride but cells already committed to division are not affected by borohydride treatment. Maximal commitment to DNA synthesis of a $NaIO_4$ oxidized cell suspension occurs after about 28 hr of incubation in medium. The committal time after periodate stimulation is identical to that after stimulation with concanavalin A. Cells treated with periodate and then reduced with borohydride immediately after oxidation are refractory to further periodate stimulation. Cells stimulated with periodate and then incubated for 6 hr before treatment with borohydride can be restimulated with periodate, indicating a turnover of membrane sites in the 6 hr period. Periodate-stimulated cells divide only once in response to the stimulation. The progeny of cells which were stimulated with periodate can be restimulated by treatment with either periodate or concanavalin A.

40288 Yeast mitochondrial RNA contains a short polyadenylic acid segment. Hendler, F.J.; Padmanaban, G.; Patzer, J.; Ryan, R.; Rabinowitz, M. (Univ. of Chicago). *Nature (London);* **258**: No. 5533, 357-359(27 Nov 1975).

Although these results provide strong evidence that a fraction of yeast mitochondrial RNA has a poly(A) segment at its 3' end, it is conceivable that the poly(A) segment is internal and has been rendered terminal by the combined action of nucleases and phosphatase. We believe this possibility to be remote because of the high molecular weight of the poly(A)-containing RNA and the homogeneity of the poly(A) segment. The inhibition of pulse labelling of the poly(A)-containing RNA by ethidium bromide, the distinct difference between the electrophoretic behavior of the poly(A) segments from yeast mitochondrial RNA and that of the cytoplasmic poly(A) and the hybridization data indicate that the results are not due to cytoplasmic contamination. The size of the short poly(A) segment of yeast mitochondrial RNA is similar to that observed in E. coli, Dictyostelium discoideum, and in silk moth chorion mRNA. That the mitochondrial poly(A)-containing RNA is mRNA is suggested by pulse label experiments. We have also demonstrated that the poly(A)-containing RNA can direct, in an E. coli cell-free system, the translation of the three peptides of yeast cytochrome oxidase that have been shown to be synthesized in vivo by yeast mitochondrial ribosomes.

40289 Spin labels for cell surfaces. Lepock, J.R.; Morse, P.D. II; Mehlhorn, R.J.; Hammerstedt, R.H.; Snipes, W.; Keith, A.D. (Pennsylvania State Univ., University Park). *FEBS (Fed. Eur. Biochem. Soc.) Lett.;* **60**: No. 1, 185-189(Dec 1975).

Yeast is used as an example of a simple eukaryotic cell system for studies on the use of spin labels that localize on the outer surfaces of membranes. These probes are used for detecting interactions or modifications that appear to be localized on the surfaces of cells. Data indicated that surface labels can be used to localize the dominant part of the spin label signal on the membrane surface. The signal remaining after addition of $NiCl_2$ or $K_3Fe(CN)_6$, representing zones unavailable to the broadening agent, may arise from sites such as membrane channels in phospholipid zones located under surface proteins, a percentage of the spin that has successfully flipped across the membrane or perhaps other sequestered zones. (HLW)

40290 Transductive coupling in bioluminescence: effects of monovalent cations and ionophores on the calcium-triggered luminescence of Renilla lumisones. Anderson, J.M.; Cormier, M.J. (Univ. of Georgia, Athens). *Biochem. Biophys. Res. Commun.;* **68**: No. 4, 1234-1241(1976).

Renilla lumisomes produce a bioluminescent flash when the vesicles are disrupted with hypotonic solutions containing Ca^{2+}. A flash is also observed in the presence of Ca^{2+} using isotonic solutions of monovalent cations under the following conditions: When the Na^+/K^+ ratio inside the lumisomal membrane is high and when this ratio outside the membrane is low. We suggest that Na^+ may be the counter ion for Ca^{2+} transport. Na^+, when outside the membrane, inhibits Ca^{2+}-triggered luminescence suggesting that Na^+ blocks Ca^{2+} channels. Ca^{2+} uptake into the lumisomal membrane, as measured by bioluminescence, is very rapid in the presence of the ionophore A23187. X537A is much less effective. The Ca^{2+} triggered bioluminescence flash observed with lumisomes provides a rapid and sensitive assay for ionophores that are specific for divalent cations such as Ca^{2+}.

40291 Model for replication repair in mammalian cells. Higgins, N.P.; Kato, K.; Strauss, B. (Univ. of Chicago). *J. Mol. Biol.;* **100**: 1-9(1976).

A model for replication repair based on the process of branch migration explains the transient production of doubly substituted DNA within the first generation of incubation in bromodeoxyuridine and the appearance of four-pronged replication forks.

40292 Increased repair in DNA growing point regions after treatment of human lymphoma cells with N-methyl-N'-nitro-N-nitrosoguanidine. Scudiero, D.; Strauss, B. (Univ. of Chicago). *Mutat. Res.;* vp(1976).

Benzoylated naphthoylated DEAE-cellulose columns can be used to separate DNA growing point regions from the bulk of the DNA. We used the columns to estimate DNA excision repair in both fractions. Repair induced by acetoxy acetyl aminofluorene (AAAF), bromomethyl benz(α)anthracene (BMBA), and methyl methanesulfonate (MMS) occurs to an equal extent in growing point and non-replicating regions of the DNA. Excision repair induced by methyl nitrosourea (MNNU) and methyl nitronitrosoguanidine (MNNG) occurs to a greater extent in growing point regions of the DNA. The overall amount of methyl nitronitrosoguanidine-induced alkylation is the same for replicating and non-replicating regions of the DNA treated in vitro. We conclude that there is some special interaction between methyl-nitronitrosoguanidine and the growing point region in vivo. We suppose that strand displacement and branch migration return DNA lesions at the growing point to a double stranded configuration at which repair is possible.

40293 Electrophotoluminescence of chloroplasts. Ellenson, J.L.; Sauer, K. (Univ. of California, Berkeley). *Photochem. Photobiol.;* **23**: 113-123(1976).

Delayed light emission emanating from preilluminated chloroplasts can be perturbed with pulsed DC electric fields (200 to 4000 V cm^{-1}). The perturbation produces a strong stimulation of chlorophyll luminescence. During the field perturbation the stimulated emission rises to a maximum, typically within 100 μs, and then decays. Two kinetic components, R (rapid) and S (slow), are distinguished on the basis of their rise and decay times and their field-dependence. The R component increases exponentially at high fields, decays within 100 to 300 μs during the field pulse and collapses with t/sub 1/2/ = 15 μs at the end of the field pulse. The S component occurs at low field, exhibits near saturation at 500 V cm^{-1}, decays with t/sub 1/2/ about 3 ms during the field pulse, and collapses with t/sub 1/2/ = 38 μs at the end of the field pulse. Studies using inhibitors, ionophores, electron donors and electron acceptors associate the R component with ion transport processes. The relation to electron transport associated with Photosystem II is discussed.

40294 Use of fluorescamine as a probe for labeling the outer surface of the plasma membrane. Hawkes, S.P.; Meehan, T.D.; Bissell, M.J. (Univ. of California, Berkeley). *Biochem. Biophys. Res. Commun.;* **68**: No. 4, 1226-1233(1976).

A rapid method was developed to label the outer surface of chick embryo fibroblasts with fluorescamine without disruption of the cell monolayer. Polyacrylamide gel electrophoresis resolved two distinct areas of fluorescence: a group of high molecular weight polypeptides and several rapidly migrating species. The latter were demonstrated by tlc to be phospholipids. Fluorescamine did not label internal components of the cell as evidenced by two intracellular proteins which were found to be non-fluorescent. Intact normal cells were labeled 3-fold more than transformed cells, indicating a possible loss of exposed sites at the surface, while disrupted cells, subsequently labeled, yielded similar amounts of fluorescence.

40295 Host-symbiont interactions. I. The lectins of legumes interact with the O-antigen-containing lipopolysaccharides of their symbiont Rhizobia. Wolpert, J.S.; Albersheim, P. (Univ. of Colorado, Boulder). *Biochem. Biophys. Res. Commun.;* **70**: No. 3, 729-737(1976).

A specific interaction between the O-antigen-containing lipopolysaccharides of Rhizobia and the lectins of their legume hosts has been demonstrated. The lectins have been purified from the seeds of four legumes and the lectins covalently attached to Agarose. The lipopolysaccharides were isolated from the four Rhizobial symbionts of the legumes. These four lipopolysaccharides were passed through the four lectin columns. In each case, the lipopolysaccharide from a Rhizobium interacts with the lectin column of its symbiont but not with the other lectin columns.

40296 Studies on human serum high density lipoproteins. Self-association of apolipoprotein A—I in aqueous solutions. Vitello, L.B.; Scanus, A.M. (Univ. of Chicago). *J. Biol. Chem.;* **251**: No. 4, 1131-1136(1976).

Human serum apolipoprotein A-I (apo-A-I), the major protein component of the human serum high density lipoproteins, was studied in aqueous solutions of differing ionic strengths and pH by the techniques of sedimentation equilibrium ultracentrifugation and frontal analysis gel chromatography. The ultracentrifugal studies indicate that apo-A-I is a self-associating system that is dependent upon protein concentration, but relatively independent of the nature of the medium. The apparent weight average molecular weights obtained from solutions of initial apo-A-I concentration between 0.2 and 0.9 mg/ml were in the range of 3.0 to 16.7 x 10^4 (monomer molecular weight = 28,014). Of the several models of self-association examined, that which gave the best theoretical fit was for the monomer-dimer-tetramer-octamer model. The self-association of apo-A-I in aqueous solutions was further documented by frontal analysis gel chromatography, which not only corroborated the ultracentrifugal results, but also indicated that the multiple species of apo-A-I in solution attain equilibrium rather rapidly. Besides having intrinsic importance, these results indicate that the solution properties of apo-A-I must be established before ligand binding studies are conducted and interpreted.

40297 Protease problem in Neurospora. Structural modification of the arom multienzyme system during its extraction and isolation. Gaertner, F.H.; Cole, K.W. (Oak Ridge National Lab., TN). *Arch. Biochem. Biophys.;* **177**: 566-573(1976).

The "aromatic complex" or "arom aggregate" of Neurospora crassa catalyzes five consecutive reactions in the central pathway leading to the biosynthesis of the aromatic amino acids. Previously, this multienzyme system was shown variously to have a molecular weight of 230,000 to 300,000 and to contain up to four subunits. Recently, a protease and a corresponding specific inhibitor have been isolated from N. crassa and, as described in this report, a new method for isolating the multienzyme system has been developed. We have made the following observations: (a) detergent (sodium dodecyl sulfate) gel electrophorograms of the "complex" isolated by two different methods are not comparable. In an earlier method, which involved more manipulations and time, the detergent gel banding patterns showed four polypeptides with molecular weights totaling about 300,000. With the new purification procedure, there are two major bands: the first with an apparent molecular weight of about 150,000 and the second with a molecular weight of 50,000. (b) When the freshly purified multienzyme system is incubated at 25°C, four new bands appear within 30 h and a fifth is visible after 40 h. (c) The formation of these new bands is prevented for up to 40 h by the addition of phenylmethanesulfonyl fluoride or a purified preparation of the specific N. crassa protease inhibitor. (d) The multienzyme system appears to remain intact, as shown by standard polyacrylamide gel electrophoresis, even after it has suffered several proteolytic clips. These results demonstrate that the purified complex is contaminated with a small but influential quantity of the inhibitable N. crassa protease and show that this protease is capable of creating an artificial subunit structure in the multienzyme system. Based on these observations, we hypothesize that the arom enzyme system is a five-component multifunctional enzyme.

40298 Protease problem in Neurospora. Variable stability of enzymes in aromatic amino acid metabolism. Lampkin, S.L. IV; Cole, K.W.; Vitto, A.; Gaertner, F.H. (Oak Ridge National Lab., TN). *Arch. Biochem. Biophys.;* **177**: 561-565(1976).

A proteolytic activity isolated from Neurospora crassa is shown to be responsible for the variable stability observed in vitro for enzymes involved in aromatic amino acid metabolism. For example, the activity of kynurenine formamidase was insensitive to the action of this protease preparation over a 24-hr period of incubation at 25°C, whereas chorismate synthase, anthranilate synthase, kynureninase, and the five activities of the arom multienzyme system were inactivated during this time. Anthranilate synthase and two of the arom system activities (dehydroquinate synthase and shikimate kinase) were inactivated by the protease preparation within 2 h. Phenylmethanesulfonylfluoride and a specific proteolytic inhibitor from N. crassa prevented inactivation of these enzymes. Spontaneous loss of activity at 25°C of purified samples of anthranilate synthase, dehydroquinate synthase and shikimate kinase was also prevented by the inhibitors. A method for purifying the inhibitor from N. crassa is described, and its use as a reagent in the analysis of proteolytic action is demonstrated.

40299 Sucrose gradient and native DNA s/sub 20,w/, an examination of measurement problems. Clark, R.W.; Lange, C.S. (Univ. of Rochester, NY). *Biochim. Biophys. Acta;* **454**: 567-577(1976).

Sedimentation coefficients of T7, T2H and T4 DNA were determined with isokinetic sucrose gradients in both 0.1 M and 1 M NaCl. The s values were completely equivalent to those measured by analytical ultracentrifuge and no reduction of s/sub 20,w/ was observed due to the presence of sucrose (anomalous sedimentation). s/sub 20,w/ values are calculated on the basis of both partial specific volume (anti ν) and apparent specific volume (phi'). Using the latter value s/sub 20,w/-molecular weight relations are derived for 0.1 M and 1 M NaCl solvents. The glucosylation of T2H and T4 DNA appears to influence s/sub 20,w/ in a manner disproportionate to the molecular weight added by glucose.

40300 Amino acid sequences of the cytochromes c-555 from two green sulphur bacteria of the genus Chlorobium. Van Beeumen, J. (Univ. of Edinburgh); Ambler, R.P.; Meyer, T.E.; Kamen, M.D.; Olson, J.M.; Shaw, E.K. *Biochem. J.;* **159**: 757-774(1976).

Amino acid sequences are proposed for the cytochromes c-555 from Chlorobium thiosulphatophilum and from the Chlorobium limicola component of 'Chloropseudomonas ethylica 2K'. Each is a single polypeptide chain, the former of 86, the latter of 99 residues, and, when aligned so as to give the best match, 47 residues are common to the two sequences. The sequences show some resemblance to those of cytochromes c_8 and f. The bacteriochlorophyll a-proteins were also isolated and purified, and their amino acid compositions compared. There are significant differences in the compositions, but not as great as those found for the cytochromes c-555. The significance of these observations for the taxonomy of the Chlorobiaceae and for the further development of the comparative biochemistry of cytochrome c is discussed.

40301 Rapid assembly of newly synthesized DNA into chromatin subunits prior to joining of small DNA replication intermediates. Hildebrand, C.E.; Walters, R.A. (Los Alamos Scientific Lab., NM). *Biochem. Biophys. Res. Commun.;* **73**: No. 1, 157-163(1976).

Nuclei from cells having the replicating DNA pulse-labeled with [^{3}H] thymidine and the nonreplicating DNA uniformly labeled with (^{14}C)thymidine were treated with micrococcal nuclease according to procedures which have been used to study the subunit structure of chromatin. Sedimentation analyses of chromatin from nuclease-treated nuclei, together with measurements of the size of newly synthesized DNA, indicate that chromatin subunits near the replication fork are more susceptible to nuclease attack than subunits in nonreplicating chromatin; newly synthesized DNA is rapidly assembled into chromatin subunits prior to joining of small DNA replication intermediates; and within 10 min after synthesis, DNA in newly replicated chromatin acquires a susceptibility to nuclease treatment similar to that of nonreplicating chromatin.

40302 Kinetics of aggregation phenomena. I. Minimal models for patch formation on lymphocyte membranes. DeLisi, C.; Perelson, A. (Los Alamos Scientific Lab., NM). *J. Theor. Biol.;* **62**: 159-210(1976).

Numerous biological processes involve the assembly of one or more monomers into aggregates or networks of interconnected units. In this paper we present the initial aspects of a mathematical theory for network formation on lymphocyte membranes. We assume the fluid mosaic membrane model is valid, that a lymphocyte possesses a homogeneous set of mobile but membrane bound receptors and that these receptors can form bimolecular complexes with antigen. We show that these complexes tend to aggregate and derive expressions for their size distribution as a function of time, antigen valence and concentration, and antigen-receptor affinity.

40303 DNA excision-repair deficiency of human peripheral blood lymphocytes treated with chemical carcinogens. Scudiero, D.; Norin, A.; Karran, P.; Strauss, B. (Univ. of Chicago). *Cancer Res.;* **36**: 1397-1403(Apr 1976).

Human peripheral blood lymphocytes stimulated with concanavalin A for 72 hr have a 10-fold greater capacity to repair DNA damage induced by N-acetoxy-2-acetylaminofluorene than do unstimulated cells. The increased capacity of concanavalin A-activated cells to repair DNA is not observed after 24 hr in culture, a time at which stimulated cells have not begun to synthesize DNA. The maximum rate of repair synthesis obtained after treatment of stimulated cells with the " large patch"-inducing agent, N-acetoxy-2-acetylaminofluorene, is twice that obtained with methyl methanesulfonate, an agent inducing "small patch" repair. The difference between the maximum rates obtained with N-acetoxy-2-acetylaminofluorene and methyl methanesulfonate is 6-fold in a human lymphoblastoid line. Unstimulated lymphocytes show almost identical rates of repair after treatment with either N-acetoxy-2-acetylaminofluorene or methyl methanesulfonate. There is close correlation between the rate of N-acetoxy-2-acetylaminofluorene-induced repair synthesis and the loss of acetylaminofluorene adducts from DNA. Treatment of lymphocytes with methyl methanesulfonate leads to degradation of cellular DNA with the production of single-stranded regions. Such degradation is not observed with N-acetoxy-2-acetylaminofluorene. We conclude that the rate of excision repair is a function of the capacity of cells for DNA synthesis and that lymphocytes that do not synthesize DNA have a limited repair capacity and cannot be used to distinguish between large and small patch repair.

40304 Biochemistry of manganese. Utter, M.F. (Case Western Reserve Univ., Cleveland). *Med. Clin. North Am.;* **60**: No. 4, 713-727(Jul 1976).

The present status of the biochemical role(s) of manganese may be summarized as follows. First, it is clear that manganese plays one or more essential roles in the maintenance of life and biological functions. Second, it seems likely, although by no means certain, that manganese fulfills this role(s) in conjunction with the action of enzymes. Third, where manganese is acting as a dissociable cofactor of an enzyme, it is difficult to correlate and evaluate the wealth of information already available from in vitro studies on the effects of manganese on various isolated enzyme systems. It is particularly difficult in these cases to establish that manganese plays a specific role since in most or all cases, metal ions other than manganese can also fulfill the role of the dissociable cofactor. Fourth, only a handful of proteins have been reported where manganese is incorporated firmly into the protein to form a metalloprotein. Only two of this small number of manganoproteins have been shown to be enzymes, pyruvate carboxylase and superoxide dismutase. Even with these two examples, the available evidence suggests that manganese may play a specific role for superoxide dismutase but not for pyruvate carboxylase. Fifth, in the various metabolic areas in which manganese might play an important role, the reactions leading to the biosynthesis of mucopolysaccharides have been strongly implicated. The evidence is based on the presence of apparent defects in connective tissues during manganese deficiency and on the marked ability of manganese to activate a number of enzymes involved in the biosynthesis of this class of compounds. The glycosyltransferases are a prime example.

40305 Poly rC-ogligo dG specific template activity of mouse viral DNA polymerase detected by isoelectric focusing. Ingalls, R.G.; Bartholomew, J.C.; Bennett, E.L. (Univ. of California, Berkeley). *Biochem. Biophys. Res. Commun.;* **73**: No. 4, 1109-1114(20 Dec 1976).

An acid fraction from polyacrylamide gel isoelectric focusing contained only DNA polymerase template activity for (rC)/sub n/ - (dG)/sub 12-18/ with little or no activity with (rA)/sub n/ - (dT)/sub 12-18. A factor which stimulated (rC)/sub n/ - (dG)/sub 12-18/ activity was also detected in low molecular weight fractions from G-100 Sephadex chromatography of the purified enzyme. Since (rC)/sub n/ - (dG)/sub 12-18/ activity is thought to be descriptive of viral DNA polymerase, this stimulation is proposed to be significant for the regulation and specificity of viral DNA synthesis.

40306 Inhibition of the tumor-initiating ability of the potent carcinogen 7,12-dimethylbenz(a)anthracene by the weak tumor initiator 1,2,3,4-dibenzanthracene. Slaga, T.J.; Boutwell, R.K. (Oak Ridge National Lab., TN). *Cancer Res.;* **37**: 128-133(Jan 1977).

Aryl hydrocarbon hydroxylase (AHH) in mouse epidermis was inducible by topical application of several tumor-initiating polycyclic aromatic hydrocarbons. The weak tumor initiator 1, 2, 3, 4-dibenazanthracene (1, 2, 3, 4-DBA), at dose level of 200 nmoles, increased AHH activity more than 10-fold over that of the acetone controls at 12 hr after treatment. Administration of the same quantity of the potent initiator 7, 12-dimethylbenz(a)anthracene (DMBA) increased AHH activity approximately 4-fold over that of the control at 12 hr after treatment. Simultaneous treatment with 200 or 100 nmoles of DMBA and 1, 2, 3, 4-DBA resulted in AHH activity that was 546 and 732 percent that of the controls, respectively, 12 hr after treatment; this was less AHH activity than was observed when 1, 2, 3, 4-DBA was administered alone. Doses of 20 nmoles or more of 1, 2, 3, 4-DBA, when given at about the same time as DMBA, effectively inhibited DMBA initiation of skin tumors in a two-stage system of tumorigenesis. The results suggest that the weak initiator 1, 2, 3, 4-DBA may program the epidermal AHH system to metabolize the strong carcinogen DMBA to noncarcinogenic intermediate(s).

40307 Studies of molecular association in biological systems by positron annihilation techniques. Jean, Y.C.; Ache, H.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg). *J. Am. Chem. Soc.;* **99**: No. 5, 1623-1625(2 Mar 1977).

The positron annihilation technique was applied to determine the complex formation constants for a series of molecular complexes of vitamin K_1 and α-tocopherolquinone with donors such as mono-, di-, and tri-n-butylamines, indole, and vitamin D_3 in cyclohexane and benzene solution. The formation constants, K/sub c/, obtained for vitamin K_1 complexes with mono-, di-, and tri-n-butylamines and vitamin D_3 all in cyclohexane solution are 0.72, 0.54, 0.24, and 0.83 M^{-1}, respectively. K/sub c/ for vitamin K_1 and α-tocopherolquinone with indole as donor in benzene solution was 0.50 and 0.29 M^{-1}, respectively.

40308 Stimulation, by two Escherichia coli supernatant proteins, of the initiation of polypeptide synthesis. Tsuda, Y.; Nakamoto, T. (Univ. of Chicago). *Biochemistry;* **16**: No. 9, 1814-1819(3 May 1977).

Two protein factors (A and B) have been partially purified from Escherichia coli supernatant which, in combination, are more effective than 0.5 M NH_4Cl in stimulating ribosomes for AcPhe-tRNA and fMet-tRNA binding, for the puromycin reaction, and for incorporating acetylphenylalanine from AcPhe-tRNA into polypeptide. The factors appear to differ from the initiation factors, the elongation factor EF-T, and ribosomal proteins. Some uncertainty exists as to whether factor B is different from EF-G. To maximize the effect of the factors in initiator tRNA binding, we preincubated the ribosomes with the factors and carried out the binding assay for a short period at 15°C. Maximal stimulation of binding occurred after about a 2-min preincubation at 37°C. Longer preincubation times were required at 15°C, and only slight stimulation was observed after preincubation at 0°C. The extent of stimulation by the factors was not affected when the NH_4Cl concentration was increased from 40 to 500 mM in the preincubation. The presence of both the 30S and 50S ribosomal subunits is required for the enhancement of AcPhe-tRNA binding. Polyphenylalanine synthesis carried out without AcPhe-tRNA is inhibited by the factors. It is suggested that the factors may act by inducing a structural rearrangement of the ribosomes.

40309 Conformational properties of purine—pyrimidine and pyrimidene—purine dinucleoside monophosphates. Ezra, F.S.; Lee, C.H.; Kondo, N.S.; Danyluk, S.S.; Sarma, R.H. (Argonne National Lab., IL). *Biochemistry;* **16**: No. 9, 1977-1987(3 May 1977).

The detailed conformational features and dynamics of heterodinucleoside monophosphates ApU, ApC, GpU, GpC, UpA, CpA, UpG, and CpG have been studied in aqueous solution by high field nuclear magnetic resonance (NMR) spectroscopy. Analysis of the resultant NMR parameters leads to a number of discernible trends throughout the series. Thus the ribose rings of the dimers exist as equilibrium mixtures of C(2′)-endo(^{2}E) reversible C(3′)-endo(^{3}E) conformers with a proclivity for the ^{3}E pucker in most cases; the C(4′)-C(5′) bonds of both nucleotidyl units show significant preference (74-96 percent) for a gg conformation and the dominant conformer (85-89 percent) about C(5′)-O(5′) is g′g′. Orientation about the C(3′)-O(3′) bond is coupled to the ribose conformational equilibrium and the system exists with a bias for the ^{3}Eg-coupled conformation in which the H(3′)-C(3′)-O(3′)-P dihedral angle occupies the narrow range of 33—55°. Dimerization, on the average, causes about 10 percent increase in gg and g′g′ populations and the g^- domain becomes increasingly populated about the C(3′)—O(3′) bond. It is proposed that the pronounced deshielding of H(5′) of the 5′-nucleotidyl units upon dimerization is associated with the presence of right-handed stacks (g^-g^-), whereas the chemical shift trends of H(5′) and H(5″) of 3′-nucleotidyl units are due to the presence of left-handed stacks (g^+g^+) in all the dimers. In pu-py dimers, the population of the g^-g^- species is found to be greater than that of g^+g^+. Also the population of g^-g^- stacks in the pu-py dimers is generally greater than in their corresponding matched py-pu dimers. Thus the base sequence has not only an explicit effect on the overall populations of the stacked species, but also on the handedness of the stacks. The present results further confirm the interdependence of conformational bonds throughout the nucleotidyl framework.

TRACER TECHNIQUES

40310 Biosynthesis of metallothionein in rat liver and kidney after administration of cadmium. Shaikh, Z.A.; Smith, J.C. (Univ. of Rochester, NY). *Chem.-Biol. Interact.;* **15**: No. 4, 327-336(Dec 1976).

The biosynthesis of the cadmium-binding protein, metallothionein, was studied in rat liver and kidney after injection of cadmium chloride. A simplified procedure for the isolation of metallothionein from liver and kidney tissues was devised. It was found that the concentration of a subcutaneously injected dose of 30 μmoles of $^{109}CdCi_2$/kg in the liver reached the maximum within 36 h. Thereafter, a slow decrease in the concentration of the isotope was noted during the 3-week period. In the kidney, the isotope was taken up in two phases. During the first phase the uptake was faster and lasted for about 4 days. The second phase of ^{109}Cd accumulation showed a slower increase in the concentration of the isotope. In both liver and kidney tissues 75-80% of the ^{109}Cd was associated with metallothionein. Amino acid incorporation studies revealed that active biosynthesis of metallothionein took place in the kidney as well as in the liver of cadmium-exposed rats. The turnover of ^{35}S-labeled metallothionein was also investigated and the half-lives of the hepatic and the renal metallothionein were found to be 2.8 and 5 days, respectively.

CYTOLOGY

REFER ALSO TO CITATION(S) 40306

40311 Sezary syndrome lymphoid cell: abnormal surface properties and mitogen responsiveness. Braylan, R.; Variakojis, D.; Yachnin, S. (Univ. of Chicago). *Br. J. Haematol.;* **31**: 553-564(1975).

The peripheral blood lymphoid cells of five patients with Sezary syndrome (SS) were examined with respect to their surface membrane characteristics and their response to mitogens. These cells showed markedly defective mitogenic responses to a broad dose range of phytohaemagglutinin (PHA), pokeweed mitogen, concanavalin A, and a rabbit antihuman lymphocyte antiserum (ATS), when compared with normal human lymphocytes. SS lymphoid cells (three patients studied) also displayed diminished or nearly absent capacity to form rosettes with unsensitized sheep erthrocytes (E-rosettes), and lacked surface immunoglobulin determinants. Despite their poor mitogenic response to ATS, they were as susceptible as normal lymphocytes to ATS-induced, complement mediated cytotoxicity. By comparison with lymphocytes from patients with chronic lymphocytic leukaemia, however, SS lymphoid cells showed decreased susceptibility to leukoagglutination by PHA. By way of contrast, three patients with mycosis fungoides having normal-appearing peripheral blood lymphocytes showed normal lymphocyte responses to mitogens, as well as normal proportions of E-rosette forming and surface immunoglobulin-bearing lymphocytes. These studies demonstrate that the SS lymphoid cell may, in some cases, lack surface properties and mitogen response characteristics of both B- and T-lymphocytes.

40312 Distribution of sister chromatid exchanges in the euchromatin and heterochromatin of the Indian muntjac. Carrano, A.V.; Wolff, S. (Univ. of California, Livermore). *Chromosoma;* **53**: 361-369(1975).

The frequency of sister chromatid exchanges (SCEs) was determined for the chromosomes (except Y_3) of the Indian muntjac stained by the fluorescence plus Giemsa (FPG) or harlequin chromosome technique. The relative DNA content of each of the chromosomes was also measured by scanning cytophotometry. After growth in bromodeoxyuridine (BrdU) for two DNA replication cycles, SCEs were distributed according to the Poisson formula in each of the chromosomes. The frequency of SCE in each of the chromosomes was directly proportional to DNA content. A more detailed analysis of SCEs was performed for the three morphologically distinguishable regions of the X-autosome composite chromosome. The SCE frequency in the euchromatic long arm and short arm were proportional to the amount of DNA. In contrast, the constitutive heterochromatin in the neck of this chromosome contained far fewer SCEs than expected on the basis of the amount of DNA in this region. A high frequency of SCE, however, was observed at the point junctions between the euchromatin and heterochromatin.

40313 Ultrastructural and physiological changes in piglet oxyntic cells during histamine stimulation and metabolic inhibition. Forte, T.M.; Machen, T.E.; Forte, J.G. (Univ. of California, Berkeley). *Gastroenterology;* **69**: No. 6, 1208-1222(1975).

Neonatal pig gastric mucosa was studied in order to correlate electrophysiological and secretory parameters with ultrastructural changes in membrane components of oxyntic cells. The non-stimulated tissue had a transmucosal resistance of about 130Ω . cm^2 while the oxyntic cells were characterized by numerous cytoplasmic tubulovesicles and short microvilli extending into patent glandular and canalicular lumina. Upon histamine-stimulation, the average rate of H^+ secretion was 8.1 μeq . cm^{-2} . hr^{-1} and the resistance decreased to 77Ω . cm^2. The changes were coupled with an immense elaboration of oxyntic cell apical and canalicular surfaces with a concomitant decrease of tubulovesicles. Thus, the observed decrease in resistance was correlated to large increases in secretory membrane area. Anoxia inhibited H^+ secretion while resistance increased to 211Ω . cm^2. Anoxic oxyntic cells were characterized by swollen mitochondria and occlusion of the lateral intercellular space and basal infoldings. Little change in the configuration of the secretory surfaces was noted, thereby suggesting that restriction of lateral and basal membranes might be responsible for the observed resistance increase. An electrical analogue of gastric mucosa is proposed on the basis of these morphological observations.

40314 Induction of permanently proliferating human lymphoblastoid lines by N-methyl-N′-nitro-N-nitrosoguanidine. Henderson, E.E.; Norin, A.J.; Strauss, B.S. (Univ. of Chicago). *Cancer Res.;* **35**: 358-363(Feb 1975).

N-Methyl-N′-nitro-N-nitrosoguanidine treatment of human peripheral blood mononuclear cells increases the frequency of lymphocyte transformation into permanently proliferating lines. The transformation is dependent on the dose of N-methyl-N′-nitro-N-nitrosoguanidine and does not occur in the presence of autologous human serum. Thirty-eight of the forty-two established lines resulting from N-methyl-N′-nitro-N-nitrosoguanidine treatment produced detectable Epstein-Barr virus antigens.

40315 Markovian analysis of cervical cell images. Pressman, N.J. (Univ. of California, Livermore). *J. Histochem. Cytochem.;* **24**: No. 1, 138-144(1976).

Markovian analysis is a method to measure optical texture based on gray-level transition probabilities in digitized images. Experiments are described that investigate the classification performance of parameters generated by Markovian analysis. Results using Markov texture parameters show that the selection of a Markov step size strongly affects classification error rates and the number of parameters required to achieve the maximum correct classification rates. Markov texture parameters are shown to achieve high rates of correct classification in discriminating images of normal from abnormal cervical cell nuclei.

40316 Purification of the chromosomes of the Indian muntjac by flow sorting. Carrano, A.V.; Gray, J.W.; Moore, D.H. II; Minkler, J.L.; Mayall, B.H.; Van Dilla, M.A.; Mendelsohn, M.L. (Univ. of California, Livermore). *J. Histochem. Cytochem.;* **24**: No. 1, 348-354(1976).

Metaphase chromosomes were isolated from a male Indian muntjac cell line, were stained with ethidium bromide and were analyzed by flow microfluorometry to establish a deoxyribonucleic acid (DNA)-based karyotype. Five major peaks were evident on the chromosomal DNA distribution corresponding to the five chromosome types in this species. The amount of DNA in each chromosome was confirmed by cytophotometric measurements of intact metaphase spreads. The five chromosome types were separated by flow sorting at rates up to several hundred chromosomes per second. The sorted chromosomes were identified by morphology and by Giemsa banding patterns. The autosomes, Numbers 1, 2 and 3, and the X + 3 composite chromosome were separated with a high degree of purity (90%). The centromere region of the X + 3 chromosome was fragile to mechanical shearing, and during isolation a small proportion of these chromosomes broke into four segments: the long arm, the short arm, the short arm plus centromere and the centromere region. A large fraction of the constitutive heterochromatin of this species is present in the centromere region of the X + 3 chromosome and in the Y chromosome; these two regions possess similar amounts of DNA and therefore sort together. Chromosome flow sorting is rapid, reproducible and precise; it allows the collection of microgram quantities of purified chromosomes.

40317 Cellular structure as revealed by visible light scattering: studies on suspensions of red blood cell ghosts. Mullaney, P.F. (Los Alamos Scientific Lab., NM); Fiel, R.J. *Appl. Opt.;* **15**: No. 2, 310-311(Feb 1976).

Red blood cells were separated from plasma by centrifugation and the cells were modified to ghosts by exposing them four times in succession to hypotonic phosphate buffer. Light-scattering measurements were made on a high-resolution light-scattering photometer. Experimental data were compared with theoretical plots derived from the coated sphere model. The main features of agreement between the coated sphere model and the experimental data are in the positions of the maxima and minima. (HLW)

40318 Nuclear envelope in the crystalline lens fiber cell. Harding, C.V.; Susan, S.R. *Invest. Ophthalmol.;* **15**: No. 5, 433-437(May 1976).

Rabbit lenses which have been fixed, dehydrated, and dried by a critical-point drying method, can be fractured through the cytoplasm of the differentiating lens fibers, exposing the cell nuclei. The fracture, under these conditions, causes a complete separation of the two membranes of the nuclear envelope from one another, thus exposing entire membrane surfaces (those which line the perinuclear space). These surfaces are not seen in their entirety in typical freeze-fracture or freeze-etch preparations, and consequently have not been described previously. The exposed membrane surfaces which line the perinuclear space have numerous convex structures of approximately 1,000 A and some larger more irregularly shaped structures. These appear to be fragments of the nuclear pore complexes. Differences in these structures between young fibers and those nearing completion of differentiation are suggested.

40319 Microfluorometric analysis of DNA content changes in a murine teratocarcinoma. Swartzendruber, D.E.; Cram, L.S.; Lehman, J.M. (Los Alamos Scientific Lab., NM). *Cancer Res.;* **36**: 1894-1899(Jun 1976).

The multipotential stem cell of the murine teratocarcinoma, embryonal carcinoma (EC), is capable of differentiation in vivo and in vitro to nonneoplastic progeny. Undifferentiated EC cells, spontaneously differentiating teratocarcinoma cells, and differentiated cells derived from EC cells were analyzed for DNA content and chromosome number distributions. Flow microfluorometric and fluorescence cytophotometric analysis of DNA content showed that EC cells had a characteristic diploid (2c) distribution, whereas several differentiated cell lines derived from EC cells had 4c DNA distributions. The tetraploid cell populations studied were capable of cell division but had restricted differentiative potential and were either of low tumorigenicity or nontumorigenic. In vivo teratocarcinomas, comprised of both EC cells and differentiated cell types, contained diploid and tetraploid populations. Chromosomally, EC cells were near-diploid (39 chromosomes) and differentiated cells were near-tetraploid (62 to 76 chromosomes). The teratocarcinoma provides a model for studying the basic mechanisms that control the growth dynamics of the rapidly and slowly proliferating cell populations present in many tumors.

40320 Cell-cycle analysis of perturbed cell populations: computer simulation of sequential DNA distributions. Gray, J.W. (Univ. of California, Livermore). *Cell Tissue Kinet.;* **9**: No. 6, 499-515(Nov 1976).

A mathematical model is presented that permits simulation of a time sequence of DNA distributions with a single set of cell-cycle parameters. The method is particularly suited to the quantitative analysis of sets of sequential DNA distributions from perturbed cell populations. The model permits determination of the durations and associated dispersions of the phases of the cell cycle as well as the point in the cell cycle at which the perturbing agent exerts its effect. The mathematical details of the simulation technique are presented, and the technique is applied to the analysis of DNA distributions from perturbed cell populations. Three cell populations are modeled: CHO-line cells released from a block at the interface of the G_1- and S-phases, 3T3 cells released from a G_1-phase block produced by serum starvation, and S49 mouse lymphoma cells responding to a block in the G_1-phase produced by N^6,$O^{2'}$-dibutyryl adenosine 3′:5′-cyclic monophosphate (Bt_2CAMP).

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 40261

GENETICS

40321 Translation of virus mRNA: comparison of reovirus and brome mosaic virus single-stranded RNAs in a wheat germ cell-free system. Davies, J. (Univ. of Wisconsin, Madison); Samuel, C.E. *Biochem. Biophys. Res. Commun.;* **65**: No. 2, 788-795(1975).

Wheat germ cell-free extracts translate reovirus ssRNA as efficiently as brome mosaic virus ssRNA. The magnesium optima, kinetics, dependence on messenger RNA concentration, and high level amino acid incorporation are similar for the animal virus and plant virus messenger RNAs. With unfractionated mRNAs from either virus, the largest messengers are not translated, or are very poorly translated. The smaller mRNAs, including the reovirus messengers for polypeptides $sigma_1$, $sigma_3$, $sigma_2$ and μ_1, are translated with fidelity. Evidence suggests that after several translation cycles, the ribosomes are not efficiently released, perhaps creating a "ribosome-jam" resulting in the synthesis of incomplete polypeptides.

40322 Formation of covalently closed cyclic dimers and catenanes of Escherichia coli phage λ in the absence of known recombination systems. Freifelder, D.; Brimlow, N.; Plotkin, S. (Brandeis Univ., Waltham, MA). *Virology;* **74**: 169-173(1976).

Escherichia coli lysogenic for lambda was superinfected with radioactive lambda and the covalently closed DNA circles were studied by zonal centrifugation in an alkaline sucrose gradient. A fraction sedimenting more rapidly than monomer circles was observed. By a variety of tests these were shown to be mostly circular dimers; a small fraction of catenated dimers was also seen. Both structures are probably formed by joining of cohesive ends. The possible significance of these structures in genetic recombination is discussed.

40323 Characterization of a temperature-sensitive mutant of Saccharomyces cerevisiae that undergoes uncontrolled protein synthesis. Gentile, J.M.; Nadakavukaren, M.J.; Richardson, A. (Illinois State Univ., Normal). *Can. J. Microbiol.;* **22**: No. 6, 873-883(1976).

A mutant of Saccharomyces cerevisiae, DW137, was isolated after treatment of a wild-type strain with ICR-170. The mutant was respiration-deficient and showed abnormal cell division when grown at 30°C. In addition, the mutant was temperature-sensitive and underwent lysis when grown at 37°C. Random spore analysis, induced reversion profiles, and complementation analysis indicated that the abnormal phenotypes were under the control of a single

recessive mutation caused by a base-pair substitution in a nuclear gene. Macromolecular analysis of the mutant at permissive and restrictive temperatures showed that at restrictive temperatures the mutant cannot synthesize DNA. Surprisingly, at restrictive temperatures, protein synthesis in the mutant continued at a rate greater than that observed at permissive temperatures. Cell death and lysis of the mutant could be prevented by treatment of cultures with cycloheximide, an inhibitor of protein synthesis. The data suggest that the abnormally high rate of protein synthesis and the inability to synthesize DNA are jointly responsible for death of the cells, and most probably play an integrating role in the incipient cell lysis.

METABOLISM

REFER ALSO TO CITATION(S) 40261, 40282, 40298, 40456, 40467, 40478, 40479, 40480

40324 Plasma lipoproteins in familial lecithin:cholesterol acyltransferase deficiency: effects of dietary manipulation. Glomset, J.A.; Norum, K.R.; Nichols, A.V.; King, W.C.; Mitchell, C.D.; Applegate, K.R.; Gong, E.L.; Gjone, E. (Univ. of Washington, Seattle). *Scand. J. Clin. Lab. Invest.;* **35**: No. 142, 3-30(1975).

To study the metabolism of the abnormal plasma lipoproteins in familial lecithin:cholesterol acyltransferase deficiency we performed five dietary experiments designed to perturb their distribution and composition. Four patients with the disease were given successive diets that differed in triglyceride, carbohydrate, or cholesterol content, and after each dietary period the lipoproteins were analyzed by combinations of preparative and analytical ultracentrifugation, gel filtration, chromatography, and disc gel electrophoresis. Lowering the intake of long chain, dietary triglyceride decreased the concentrations of the large very low density lipoproteins, the large and intermediate low density lipoproteins, and the small high density lipoproteins by as much as 79%, but either increased or did not change the concentrations of the small very low and low density lipoproteins. Re-adding long chain triglyceride to the diet generally reversed these effects, but increasing the intake of carbohydrate did not. Furthermore, decreasing the dietary cholesterol without lowering the dietary triglyceride only decreased the concentration of plasma cholesteryl ester. We conclude that the concentrations of the large very low and low density lipoproteins, the intermediate-sized low density lipoproteins, and the small high density lipoproteins are related to the absorption and subsequent transport of long chain dietary fatty acids. Since these lipoproteins are rich in unesterified cholesterol and lecithin, two polar lipids that form a substantial part of the surfaces of chylomicrons, components of chylomicron surfaces may accumulate in the patients' plasma following enzymic removal of chylomicron triglyceride and contribute to several of the abnormal lipoproteins.

40325 Action of 1,25-dihydroxyvitamin D_3 and a diphosphonate on calcium metabolism in rats. Bonjour, J.P.; Trechsel, U.; Fleisch, H.; Schenk, R.; DeLuca, H.F.; Baxter, L.A. (Univ., Bern). *Am. J. Physiol.;* **229**: No. 2, 402-408(Aug 1975).

The effect of 1,25-dihydroxycholecalciferol (1,25-$(OH)_2D_3$) on Ca balance, ^{45}Ca kinetics, and bone morphology has been studied in control rats and rats given disodium ethane-1-hydroxy-1,1-diphosphonate (EHDP), 10 mg P/kg sc per day. This large dose of EHDP is known to inhibit bone mineralization and intestinal calcium absorption and to depress the endogenous production of 1,25-$(OH)_2D_3$. In control rats, 1,25-$(OH)_2D_3$ increased intestinal calcium absorption. However, in contrast to the enhanced calcium absorption that results from an augmentation of dietary calcium, the 1,25-$(OH)_2D_3$-induced augmentation of calcium absorption does not lead to a rise in calcium retention, the intestinal effect being matched by an increased excretion of urinary calcium. The EHDP-induced decrease of intestinal calcium absorption could be completely prevented by the concomitant administration of 1,25-$(OH)_2D_3$ but not the inhibition of bone mineralization. Therefore, in contrast to the impairment of calcium absorption, that of bone mineralization brought about by large doses of EHDP cannot be merely attributed to a decreased production of 1,25-$(OH)_2D_3$.

40326 Analogies between embryonic (T/t) antigens and adult major histocompatibility (H-2) antigens. Artzt, K.; Bennett, D. (Cornell Univ., New York). *Nature (London);* **256**: No. 5518, 545-547(14 Aug 1975).

Progress has been made in defining cell surface components specified by the T/t locus in the mouse, both in their expression on sperm and, in the one case studied, on normal embryonic cells and tetratocarcinoma. Some striking analogies between this putative embryonic cell recognition system and the adult major histocompatibility complex are presented.

40327 Improved entrapment of drugs in modified liposomes. Tsujii, K.; Sunamoto, J.; Fendler, J.H. (Texas A and M Univ., College Station). *Life Sci.;* **19**: No. 11, 1743-1749(1976).

Incorporation of 8-azaguanine and 6-mercaptopurine into single compartment dipalmitoyl-DL-α-phosphatidylcholine liposomes has been increased dramatically by the presence of chloranil. The charge transfer complex readily decomposes to the parent donor drug and chloranil acceptor. Chloranil, however, may be toxic. Using 3,5-dinitrobenzoyl-n-butylamide and 3,5-dinitrobenzoyl phosphatidylethanolamine as electron donors did not result in enhanced entrapments.

40328 Host-pathogen interactions. X. Fractionation and biological activity of an elicitor isolated from the mycelial walls of Phytophthora megasperma var.sojae. Ayers, A.R.; Ebel, J.; Valent, B.; Albersheim, P. (Univ. of Colorado, Boulder). *Plant Physiol.;* **57**: 760-765(1976).

An elicitor of phytoalexin production in soybean (Glycine max L.) tissues was isolated from purified Phytophthora megasperma var. sojae mycelial walls by a heat treatment similar to that used to solubilize the surface antigens from the cell walls of Saccharomyces cerevisiae. The wall-released elicitor is a discrete, minor portion of the P. megasperma var. sojae mycelial walls. The elicitor released from the mycelial walls was divided by diethylaminoethylcellulose and concanavalin A-Sepharose chromatography into four fractions, each having different chemical characteristics. The four fractions were obtained from each of the three races of P. megasperma var. sojae. The corresponding fractions from each of the three races are very similar in composition and elicitor activity. The results suggest that the elicitor activity of each fraction resides in the glucan component of the fraction. Evidence is presented to demonstrate that the elicitors are not race-specific and that the accumulation of glyceollin is not sufficient to account for race-specific resistance.

40329 Host-pathogen interactions. XI. Composition and structure of wall-released elicitor fractions. Ayers, A.R.; Valent, B.; Ebel, J.; Albersheim, P. (Univ. of Colorado, Boulder). *Plant Physiol.;* **57**: 766-774(1976).

The structures of the four wall-released elicitor fractions isolated from the Phytophthora megasperma var. sojae mycelial walls have been examined. The results demonstrate that fraction I is primarily composed of a branched β-1,3-glucan, similar in structure to the extracellular elicitors described previously. Fractions II and IV are primarily composed of a highly branched mannan-containing glycoprotein, with fraction IV richer in protein than fraction II. Fraction III contains, attached to protein, a mixture of the two polysaccharide types found in fraction I and in fractions II and IV. The structural data presented here, in concert with the biological data presented in the previous two papers, demonstrate that the only compound produced by P. megasperma var. sojae which contains elicitor activity is the glucan. Evidence is presented that the terminal glycosyl residues of the glucan are required for elicitor activity. In addition, it is demonstrated that 90 percent of the glucan can be removed enzymically without any loss of biological activity. The active residue of the enzymic digestion is a highly branched 3- and 3,6-linked glucan containing about 4 percent mannosyl residues. The results presented suggest that the mannosyl residues of the glucan, which represent only about 1 percent of the undergraded glucan, are likely to participate in the active site of this molecule. The role of elicitors and phytoalexins in host-pathogen interactions is discussed. Evidence for the existence of and possible identity of another factor which determines race specificity of host-pathogen interactions is summarized.

40330 Host-pathogen interactions. XII. Response of suspension-cultured soybean cells to the elicitor isolated from Phytophthora megasperma var.sojae, a fungal pathogen of soybeans. Ebel, J.; Ayers, A.R.; Albersheim, P. (Univ. of Colorado, Boulder). *Plant Physiol.;* **57**: 775-779(1976).

The glucan elicitor isolated from the mycelial walls of Phytophthora megasperma var. sojae, the fungus which causes stem and root rot in soybeans, stimulates the activity of phenylalanine ammonia-lyase and the accumulation of glyceollin in suspension-cultured soybean cells. Nigeran, a commercially available fungal wall glucan, was the only other compound tested which has any activity in this system. Glyceollin is a phenylpropanoid-derived phytoalexin which is toxic to P. megasperma var. sojae. Evidence is presented to support the hypothesis that the action of elicitors in stimulating phytoalexin synthesis is not species or variety specific but, rather, is part of a general defensive response of plants.

40331 Host-pathogen interactions. IX. Quantitative assays of elicitor activity and characterization of the elicitor present in the extracellular medium of cultures of Phytophthora megasperma var sojae. Ayers, A.R.; Ebel, J.; Finelli, F.; Berger, N.; Albersheim, P. (Univ. of Colorado, Boulder). *Plant Physiol.;* **57**: 751-759(1976).

Resistance of soybean (Glycine max L.) seedlings to Phytophthora megasperma var. sojae (Pms) is in part due to the accumulation in infected tissue of a compound which is toxic to Pms. The accumulation of this compound, a phytoalexin called glyceollin, is triggered by infection, but it can also be triggered by molecules,

"elicitors", present in cultures of Pms. The ability of the Pms elicitor to stimulate phytoalexin accumulation in soybean tissues has been used as the basis for biologicl assays of elicitor activity. Two bioassays were developed and characterized in this study of the Pms elicitor. These bioassays use the cotyledons and the hypocotyls of soybean seedlings. The cotyledon assay was used to characterize the extracellular Pms elicitor. This elicitor was isolated from Pms cultures and purified by ion exchange and molecular sieving chromatography. The extracellular Pms elicitor was determined to be a predominantly 3-linked glucan, which is similar in composition and structure to a polysaccharide component of Pms mycelial walls.

40332 Dietary carbohydrate effects upon magnesium metabolism in sheep. Madsen, F.C.; Lentz, D.E.; Miller, J.K.; Lowrey-Harnden, D.; Hansard, S.L. (Comparative Animal Research Lab., Oak Ridge, TN). *J. Anim. Sci.;* **42**: No. 5, 1316-1322(1976).

Apparent magnesium (Mg) absorption was measured in mature sheep fed hay or vegetative grass, each with and without supplemental glucose (water-soluble carbohydrate). Glucose supplemented in varying levels to hay increased apparent Mg absorption (linear, P less than 0.01) and urinary-Mg output (linear, P less than 0.01). Glucose added to vegetative grass did not change Mg absorption, but plasma-Mg concentrations were higher (P less than 0.05) than controls. Absorption and urinary loss of Mg were positively correlated (P less than 0.01) when hay or grass was fed, with or without glucose. Varying dietary glucose levels in hay or grass did not influence (P greater than 0.05) apparent absorption of calcium (Ca), potassium (K), or phosphorus (P). This study suggests that supplementation with a readily available carbohydrate during periods of dietary Mg deficiency may reduce the rate of plasma-Mg decline characteristic of ruminants grazing spring grass.

40333 Nitrogen nutrition of Myriophyllum spicatum: uptake and translocation of ^{15}N by shoots and roots. Nichols, D.S.; Keeney, D.R. (Univ. of Wisconsin, Madison). *Freshwater Biol.;* **6**: No. 2, 145-154(Apr 1976).

Intact Myriophyllum spicatum plants were grown in compartmentalized containers in a growth room so that the roots were separated from the shoots by a watertight partition. Nitrogen ^{15}N was added to the water or sediment to trace the uptake of inorganic N by the plant shoots or roots. Myriophyllum spicatum is capable of taking up inorganic N through both roots and shoots. Plant N requirements can apparently be met by root uptake alone. However, when about 0.1 mg/l of NH_4-N was present in the water, foliar uptake supplied more N to the plants than did root uptake. Foliar uptake of NH_4-N was found to be several times faster than that of NO_3-N when both forms of N were present in the water. Only about 1 percent of the N taken up by the roots was subsequently released to the water through the foliage.

40334 Insulin kinetics after portal and peripheral injection of [^{125}I]insulin. I. Data analysis and modeling. Pilo, A.; Navalesi, R.; Ferrannini, E. (Univ., Pisa, Italy). *Am. J. Physiol.;* **230**: No. 6, 1626-1629(Jun 1976).

The kinetics of insulin are commonly investigated by intravenous administration of labeled hormone, whereas native insulin is removed by the liver to some extent before mixing in the systemic circulation. A mathematical model has been developed which makes it possible to interpret the experimental data obtained by peripheral plasma sampling after portal and peripheral injection of the tracer. Equations are given that allow for the computation of metabolic clearance rate, initial distribution volume, production rate, and body mass of insulin. It is demonstrated that hepatic extraction can be calculated from the difference between the clearance rate values obtained after portal and peripheral injection of the tracer; an estimate of total hepatic catabolism is also derived. The assumptions and limitations underlying this mathematical analysis are discussed.

40335 Heavy metal-induced alterations in ion transport by turtle urinary bladder. Schwartz, J.H.; Flamenbaum, W. (Walter Reed Army Inst. of Research, Washington, DC). *Am. J. Physiol.;* **230**: No. 6, 1582-1589(Jun 1976).

Previous studies of heavy metal salt-induced acute renal failure demonstrated abnormalities of fluid and solute transport by nephron segments and alterations in glomerular filtration rate and renal hemodynamics. To determine the direct effects of uranyl nitrate (UN) or $HgCl_2$ on ion transport, their effects were studied on the isolated urinary bladder of the turtle. Unidirectional $^{24}Na^+$ and $^{36}Cl^-$ fluxes were measured across short-circuited bladders. The addition of 0.1 mM UN to the mucosal solution resulted in a 69.9 +- 4 percent (SEM) decrease in short-circuit current (SCC) without change in transepithelial resistance. Net Na^+ flux (7.95 +- 0.81 μeq/h per 8 cm^2) decreased by the same magnitude as the SCC, primarily due to a 5.75 +- 0.76 μeq/h per 8 cm^2 decrease in the mucosal- (M) to-serosal (S) Na^+ flux. Net Cl^- flux decreased also primarily due to a decrease in M-to-S Cl^- flux. Addition of 0.4 mM UN to S did not measurably affect the SCC or ion fluxes. The addition of 10 μM $HgCl_2$ in another group of bladders reduced SCC and M-to-S Na^+ flux by 81 +- 7 percent without change in Cl^- fluxes or resistance. The removal of either UN or $HgCl_2$ from M by washing did not reverse the decreased SCC, but after washing addition of either dithiothreitol, 2 mM, or amphotericin B, 20 μg/ml, to M completely reversed the effects of UN or $HgCl_2$ on SCC. These studies suggest that heavy metal salts inhibit Na^+ transport by the turtle bladder without altering passive ion fluxes.

40336 Analyses of gastric emptying in bluegill (Lepomis macrochirus). El-Shamy, F.M. (Univ. of Wisconsin, Madison). *J. Fish. Res. Board Can.;* **33**: No. 7, 1630-1633(Jul 1976).

Bluegill (Lepomis macrochirus) fed a single meal averaging 111.6 mg dry wt (2.19% body wt on a wet fish and food basis) showed an average of 60 mg (54%) of the meal remaining after 8 h of digestion compared to 71 mg (59%) of an equivalent amount of food (119.6 mg or 2.04% body wt) fed in two consecutive meals. Fish fed a single meal averaging 167.2 mg (2.74% body wt) showed an average of 41% of the meal remaining 12 h after feeding, while fish fed three consecutive meals totaling 140.3 mg (2.51% body wt), showed an average of 47% of the food intake remaining 12 h after they were first fed. Two statistical models--an exponental and a multiple regression--relating food digested to meal size and time of feeding were developed. Both statistical models, when based on results of fish fed single meals, failed to predict values comparable to those observed for bluegill fed multiple meals.

TRACER TECHNIQUES

40337 DNA turnover and thymidine re-utilization in mouse tissues. Myers, D.K.; Feinendegen, L.E. (Kernforschungsanlage Juelich GmbH, Ger.). *Cell Tissue Kinet.;* **9**: 215-221(1976).

Mice were injected intravenously with tritiated thymidine (TdR) and ^{125}I-labeled iododeoxyuridine (IUdR) in low doses to provide a simultaneous labeling of tissue DNA with non-toxic amounts of these two precursors. The total activity per organ and the ratio of the two isotopes were measured in the DNA at various times between 1 and 15 days after the injection. Since TdR from dying cells is re-utilized more efficiently than IUdR from the same cells, more labeled TdR than IUdR was retained in the tissue DNA in these experiments. From the slopes of the regression lines, the true rate of turnover of replicating tissue DNA and the percent re-utilization of TdR were calculated. Re-utilization of TdR varied from 37 to 60 percent in the six tissues examined.

MEDICINE

40338 Ultrasonic pulse-echo determination of thermal injury in deep dermal burns. Goans, R.E.; Cantrell, J.H. Jr.; Meyers, F.B. (Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Med. Phys.;* **4**: No. 3, 259-263(May 1977).

Burns of all kinds represent a serious class of traumatic injury, affecting over two million people annually in the United States alone. Of this number, over 70 000 are serious enough to require extended hospitalization. Currently, there is no sensitive, quantitative technique for measuring the depth of thermal damage in such injuries. An ultrasonic pulse-echo technique is described here whereby such information can be obtained within a few minutes postburn. Results from model porcine experiments are given to illustrate the usefulness of the method, and implications for the clinical care of human burn victims are discussed.

TRACER TECHNIQUES

40339 Autonomous nodule of the thyroid: correlation of patient age, nodule size, and functional status. Blum, M.; Shenkman, L.; Hollander, C.S. (New York Univ., NY). *Am. J. Med. Sci.;* **269**: No. 1, 43-50(1975).

In light of new techniques for measuring circulating thyroid hormones and for studying the thyroid gland, we present our experience with 35 patients with solitary autonomous nodules of the thyroid to define more precisely the clinical course of patients with this disorder. The patients ranged in age from 19 to 80 years and 31 of the 35 were female. Younger patients were generally euthyroid and sought attention because of a thyroid mass; virtually all older patients were hyperthyroid. Eighteen had obvious clinical features of hyperthyroidism and 5 over age 70 had apathetic hyperthyroidism; all 5 of the elderly and 13 of the 18 under age 70 had elevated thyroxine (T_4) and triiodothyronine (T_3) levels. Isolated elevation of T_3 and elevated basal metabolic rate were observed in 5 previously untreated clinically hyperthyroid young patients. In each of these, thyroid uptake of ^{131}I was not suppressible with exogenous T_3 and BMR was elevated in those tested. Two elderly patients, who had previously been treated for conventional hyperthyroidism with radioactive iodine, had T_3 toxicosis when hyperthyroidism recurred. There was a strong positive correlation between the age of the patient, the size of the nodule and the thyroid functional state. The mean area of the nodules projected on ^{131}I rectilinear scan for euthyroid patients was 5.1 cm^2. The mean area of the nodules in

hyperthyroid subjects was significantly higher, 13.4 cm^2 in patients with T_3 toxicosis and 19.3 cm^2 in subjects with conventional hyperthyroidism. Progression from a euthyroid state to hyperthyroidism was observed in four patients. One of these became thyrotoxic within days after an injection of iodinated contrast medium. Spontaneous resolution of nodules occurred in two patients.

40340 (HRP—0009207) **Acquisition and use of computer-assisted tomography in Rhode Island.** (Health Planning Council, Inc., Providence, R.I. (USA)). Jan 1976. 34p. NTIS $4.00.

Guidelines for the acquisition and use of computer-assisted tomographic (CAT) scanners are presented by the Health Planning Council, Inc. The background and technology of CAT is noted, and resource and operational requirements are considered. General policies for assessing and meeting the need for CAT in Rhode Island are outlined. General recommendations include: adoption of a policy of limited and regionalized initial placement of CAT scanners; affiliation of those hospitals which will use the scanners with the Brown University Program in Medical Sciences; establishment of the CAT function as a hospital-based activity in a separate department; establishment of referral mechanisms to assure appropriate statewide access to CAT scanners; and placement of scanners in relation to a demonstrated service area need. Specific recommendations are: limitation of initial acquisitions to hospitals with active radiology, neurology, and neurosurgery departments; consideration by both Miriam and Rhode Island hospitals of the purchase of body scanners; periodic assessment of the utilization of scanners at these hospitals; adoption of policies and guidelines identifying the characteristics of appropriate locations for CAT scanner placement; consideration of the advisability of legislated certificate-of-need processes; and reimbursement by Blue Cross / Blue Shield only for brain scanning until such time as applications of body scanning are appropriately demonstrated. Supplementary data are appended. (GRA)

40341 (PB—251905) **Cannabinoid assays in humans. Final report.** Willette, R.E. (National Inst. on Drug Abuse, Rockville, Md. (USA). Div. of Research). May 1976. 130p. (DHEW/PUBL/ADM—76/339). NTIS $6.00.

See also PB—249092.

Contents: Quantitation of cannabinoids in biological fluids by radioimmunoassay; Separate radioimmune measurements of body fluid delta 9 THC and 11-nor-9-carboxy-delta 9-THC; Radioimmunoassay of delta 9-tetrahydrocannabinol; Determination of THC and its metabolites by EMIT homogeneous enzyme immunoassay--A summary report; Separation and sensitive analysis of tetrahydrocannabinol in biological fluids by HPLC and GLC; Determination of delta 9 tetrahydrocannabinol in human blood serum by electron capture gas chromatography; Detection and quantification of tetrahydrocannabinol in blood plasma; A method for the identification of acid metabolites of tetrahydrocannabinol (THC) by mass fragmentography; Quantitation of cannabinoids in biological specimens using probability based matching gas chromatography/mass spectrometry; Quantitation of delta 9-tetrahydrocannabinol in body fluids by gas chromatography/chemical ionization-mass spectrometry; HPLC-MS determination of delta-9-tetrahydrocannabinol in human body samples; Analytical methods for the determination of cannabinoids in biological materials. (GRA)

40342 (PB—255892) **Quality control for scintillation cameras. Final report.** (Bureau of Radiological Health, Rockville, Md. (USA)). Jun 1976. 55p. (FDA/BRH—76/90; DHEW/PUBL/FDA—76/8046). NTIS $4.50.

In order to insure the detectability of faults that may occur in the imaging performance of a scintillation camera system, a monitoring program establishing quality control should be implemented in every facility using these devices. The production of high quality images on a long-term basis can only be accomplished by monitoring the operational status of a scintillation camera at frequent intervals. This report summarizes the components of quality control program and outlines most useful quality control techniques for scintillation cameras. Recommendations based on a minimum daily monitoring program will be presented. In addition the report contains a flow chart of operational and quality control procedures for scintillation cameras, a glossary of performance parameters and terms, and a compilation of multipurpose phantoms available for use in nuclear medicine. (GRA)

40343 (PB—256029) **A pilot study of nuclear medicine reporting through the medically oriented data system. Technical report.** McIntyre, A.B.; Hamilton, D.R.; Grant, R.C. (Bureau of Radiological Health, Rockville, Md. (USA)). Jun 1976. 32p. (FDA/BRH—76/91; DHEW/PUBL/FDA—76-8045). NTIS $4.00.

The report documents nuclear medicine information collected from six hospitals during a pilot study of the Medically Oriented Data Systems (MODS). There is marked variability in the data reported from individual hospitals with respect to the procedures performed and patient characteristics. The results of this study may not be representative of all hospitals, but they do provide a detailed illustration of nuclear medicine as practiced in the participating hospitals. (GRA)

MICROBIOLOGY

REFER ALSO TO CITATION(S) 39974

40344 **Elimination of single-strand breaks in phage DNA.** Freifelder, D. (Brandeis Univ., Waltham, MA). *Virology;* **74**: 265-267(1976).

The natural single-strand breaks found in the DNA of Escherichia coli phages T7 and lambda can be eliminated either by growth in a medium maintained at slightly alkaline pH or by growth on a host carrying the mutation lop8.

40345 **Kinetics of cell fusion induced by a syncytia-producing mutant of herpes simplex virus type I.** Person, S.; Knowles, R.W.; Read, G.S.; Warner, S.C.; Bond, V.C. (Pennsylvania State Univ., University Park). *J. Virol.;* **17**: No. 1, 183-190(Jan 1976).

We have isolated a number of plaque-morphology mutants from a strain of herpes simplex virus type I which, unlike the wild type, cause extensive cell fusion during a productive viral infection. After the onset of fusion, there is an exponential decrease in the number of single cells as a function of time after infection. At a multiplicity of infection (MOI) of 3.8 plaque-forming units per cell, fusion begins 5.3 h after infection with the number of single cells decreasing to 10 percent of the original number 10.2 h after infection. As the MOI is gradually increased from 0.4 to 8, the onset of fusion occurs earlier during infection. However, when the MOI is increased from 8 to 86, the onset of fusion does not occur any earlier. The rate of fusion is independent of the MOI for a MOI greater than 1. The rate of fusion varies linearly with initial cell density up to 3.5 x 10^4 cells/cm^2 and is independent of initial cell density at higher cell concentrations. To assay cell fusion we have developed a simple quantitative assay using a Coulter counter to measure the number of single cells as a function of time after infection. Data obtained using a Coulter counter are similar to those obtained with a microscope assay.

40346 **Microbial oxidation and assimilation of propylene.** Cerniglia, C.E.; Blevins, W.T.; Perry, J.J. (North Carolina State Univ., Raleigh). *Appl. Environ. Microbiol.;* **32**: No. 6, 764-768(Dec 1976).

Hydrocarbon-utilizing microorganisms in our culture collection oxidized propylene but could not utilize it as the sole source of carbon and energy. When propane-grown cells of Mycobacterium convolutum were placed on propylene, acrylate, the terminally oxidized, three-carbon unsaturated acid, accumulated. A mixed culture and an axenic culture (strain PL-1) that utilized propylene as the sole source of carbon and energy were isolated from soil. Respiration rates, enzyme assays, fatty acid profiles, and $^{14}CO_2$ incorporation experiments suggest that both the mixed culture and strain PL-1 oxidize propylene via attack at the double bond, resulting in a C_2 + C_1 cleavage of the molecule.

MORPHOLOGY

REFER ALSO TO CITATION(S) 40272

PATHOLOGY

REFER ALSO TO CITATION(S) 40328, 40329, 40330, 40331

40347 (LA-UR—77-532) **Automated chest x-ray analysis.** Hall, E.L.; Rouge, B.K.; Kruger, R.P. (Los Alamos Scientific Lab., N.Mex. (USA)). 1977. Contract W-7405-ENG-36. 10p. (CONF-760832—25). P 02/MF A01.

From 20. annual SPIE technical symposium; San Diego, California, United States of America (USA) (23 Aug 1976).

A computer hardware-software system has been developed for extracting optical and digital measurements from chest x-rays and using these measurements to classify the severity of lung disease. The system consists of a digital image scanner and an optical system consisting of an x-y controller for film transportation and an RSI Fraunhofer diffraction pattern sampling unit. Initially the classification has been of opacity textural patterns associated with coal workers pneumoconiosis (CWP). However, the system appears to be expandable to all diseases described in the international standard which include lung disease, heart disease, and cancer with only software modification. Recently extensions to large opacity detection, measures of lung vascularity and lung and heart volume have been made. Results indicate classification accuracy rates for pneumoconioses comparable to visual readings of the films by expert radiologists, and significantly better than non-radiologist physicians who often read these films.

40348 **Survival with mammary cancer related to the interaction of germinal center hyperplasia and sinus histiocytosis in axillary and**

internal mammary lymph nodes. Hunter, R.L.; Ferguson, D.J.; Coppleson, L.W. (Univ. of Chicago). *Cancer;* **36**: No. 2, 528-539(Aug 1975).

In a review of the histologic sections of axilliary and internal mammary lymph nodes removed during surgery for invasive ductal carcinoma of the breast, we found that 16 of 17 patients in hom sinus histiocytosis was the dominant lymphoid proliferative reaction are alive with no evidence of cancer 5 or more years after operation. In contract, 5 of 6 patients in whom germinal center hyperplasia was the only significant reaction found died of cancer in less than 5 years. Patients with both sinus histiocytosis and germinal center hyperplasia in significant amounts had survival that was intermediate; 17 of 25 of these patients are currently alive and apparently free of cancer. In addition, 5 of 6 patients in whom no evidence was found of any lymphoid proliferative reaction and 3 of 3 patients with diffuse cortical hyperplasia in their axillary lymph nodes died of cancer in less than 5 years. Germinal center hyperplasia was associated with nodal metastases anatomically in individual lymph nodes and statistically in the series of cases. The internal mammary lymph nodes of most cases showed less proliferative reaction to tumor than the axillary lymph nodes. The pattern of proliferative reactions in lymph nodes and its correlation with survival after surgery suggest that different immune reactions may either suppress or enhance the growth of carcinoma of the breast.

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 40453, 40455

40349 (COO—3327-26) **Histocompatibility typing in mongrel populations: man and dog. Final report for period March 1, 1968—February 28, 1977.** Blumenstock, D.A. (Mary Imogene Bassett Hospital, Cooperstown, N.Y. (USA)). Mar 1977. Contract EY-76-S-02-3327. 5p. P 02/MF A01.

Assorted procedures for controlling graft vs. host reaction by pretreatment of marrow with antithymocyte sera, anti-lymphocyte sera, anti-brain (anti-theta) sera, anti-globulin sera, and Fab preparations were tried in dogs and mice. These procedures, whose modus operandi is an intent to remove thymus-conditioned lymphocytes from the donor marrow, have not proved successful to date primarily because of associated damage to hematopoietic stem cell potential.

40350 (ERDA-tr—241, pp 73-78) **Effect of the yeast polysaccharide, mannan, on hemopoiesis in intact mice.** Andrianova, I.E.; Razorenova, V.A.; Vitovskaya, G.A.; Rogozkin, V.D.; Elinov, N.P. 1976. Translated from Radiobiologiya; 16: No. 5, 703-706(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

It was established in experiments on noninbred white male mice that marked changes of a complex nature, which last a long time, occur in the hemopoietic system following a single intravenous injection of mannan. At the early stages, these changes are related to a redistribution reaction. At the later stages (2 hours to 3 days), the increased number of dividing cells, rapid increase in number of regenerative forms and reticular cells are indicative of increased proliferative activity of bone marrow cells.

40351 Interkingdom fusion between human (HeLa) cells and tobacco hybrid (GGLL) protoplasts. Jones, C.W. (Brookhaven National Lab., Upton, NY); Mastrangelo, I.A.; Smith, H.H.; Meck, R.A. *Science;* **193**: No. 4251, 90-93(30 Jul 1976).

The fusion of human HeLa cells with tobacco protoplasts has been accomplished with the use of polyethylene glycol. The sequence from heterocellular adherence to heterokaryon formation has been followed with light microscopy and confirmed by autoradiographs of heterokaryons containing unlabeled tobacco nuclei and tritium-labeled HeLa nuclei. The HeLa nucleus retained its integrity in the tobacco cytoplasm up to 6 days after fusion.

40352 Effects of nitrate and ammonium enrichment on growth and nitrogen physiology in Fucus spiralis. Topinka, J.A. (Bigelow Lab. for Ocean Sciences, West Boothbay Harbor, ME); Robbins, J.V. *Limnol. Oceanogr.;* **21**: No. 5, 659-664(Sep 1976).

Growth and physiological responses of whole specimens of Fucus spiralis to nitrate and ammonium enrichment were measured in a continuous-flow system using seawater from the Massachusetts coast. As physiological indicators of nitrogen status, total C and N, dark ammonium uptake, and respiratory stimulation by ammonium were examined in plant apices. Total nitrogen content and growth rate increased with the level of nitrate or ammonium addition, both supporting similar growth. Dark ammonium uptake was not as sensitive an indicator of nitrogen status as the respiratory stimulation by ammonium. Although the growth of F. spiralis may become nitrogen limited, plants did not exhibit severe nitrogen deficiency responses.

40353 Method for continuous in vivo measurement of hemolymph conductivity in crabs. Engel D.W. (National Marine Fisheries Service, Beaufort, NC); Nichols, C.D. *J. Exp. Mar. Biol. Ecol.;* **26**: No. 2, 203-209(1977).

A miniaturized conductivity measuring device has been developed to monitor in vivo hemolymph conductivity in crabs. The device measures the conductivity by means of implanted platinum electrodes, and transmits the data via raidotelemetry to a receiving station through 6 ft of water. Crabs used in these investigations survived the insertion of the conductivity probe and appeared to behave and feed normally for up to one week with the probe in position. Blue crabs, Callinectes sapidus Rathbun, which were acclimated to either 5 or 35‰ were abruptly transferred to 35 and 5 ‰, respectively and the rate of change of hemolymph conductivity successfully monitored. The time required for the conductivity (ionic composition) change in the hemolymph of the crabs after transfer varied from 12 to 16 h for crabs transferred from 35 to 5‰ to less than an hour when the change was from 5 to 35‰.

40354 Electrical potentials from the eye and optic nerve of Strombus: effects of electrical stimulation of the optic nerve. Gillary, H.L. (Univ. of Hawaii, Honolulu). *J. Exp. Biol.;* **66**: 159-171(Feb 1977).

Photic stimulation of the mature eye of Strombus can evoke in the optic nerve "on" activity in numerous small afferent fibres and repetitive "off" bursts of afferent impulses in a smaller number of larger fibres. Synchronous invasion of the eye by electrically evoked impulses in small optic nerve fibres (apparently the "on" afferents, antidromically activated) can evoke a burst of impulses in the larger "off" fibres which propagate away from the eye. Invasion of the eye via one branch of optic nerve can evoke an answering burst in another branch. Such electrically evoked bursts are simil•r to light-evoked "off" bursts with respect to their impulse composition, their ability to be inhibited by illumination of the eye, and their susceptibility to $MgCl_2$ anaesthesia. Invasion of the eye by a train of repetitive electrically evoked impulses in the absence of photic stimulation can give rise to repetitive "off" bursts as well as concomitant oscillatory potentials in the eye which are similar to those normally evoked by the cessation of a photic stimulus. The electrically evoked "off" bursts appear to be caused by an excitatory rebound following the cessation of inhibitory synaptic input from photoreceptors which can be antidromically activated by electrical stimulation of the optic nerve. The experimental results suggest that the rhythmic discharge of the "off" fibres evoked by the cessation of a photic stimulus is mediated by the abrupt decrease of inhibitory synaptic input from the receptors.

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 39409

40355 Climate and food workshop: a report. Newell, R.E.; Tanaka, M.; Misra, B. (Massachusetts Inst. of Tech., Cambridge). *Bull. Am. Meteorol. Soc.;* **57**: No. 2, 192-198(Feb 1976).

We report on a workshop designed to study some of the interrelationships between climate and food production, emphasizing the use of readily available climatological data. Closer monitoring of contemporary climatic events can apparently give a valuable lead to possible expected grain yields in the U.S.S.R., as these are sometimes influenced by blocking highs which tend to exhibit persistence. Rice cultivation in India is strongly influenced by rainfall, whereas in Japan, extensive irrigation has largely eliminated this dependence, and temperature is the governing factor. The workshop findings have prompted us to start more detailed studies of the climate-food interrelationships, from which we hope to assess the value of monitoring current climatic conditions.

40356 Bioenergetic considerations in cereal breeding for protein improvement. Bhatia, C.R.; Rabson, R. (International Atomic Energy Agency, Vienna). *Science;* **194**: No. 4272, 1418-1421(24 Dec 1976).

The bioenergetic implications of changing cereal grain protein concentrations and amino acid compositions by plant breeding are examined. It is shown that increased inputs of carbon assimilates and nitrogen are necessary when increasing protein concentration in cereal grains while maintaining high yields. Also, energetic requirements for obtaining endosperm proteins with a high lysine content in genotypes of maize and barley are slightly higher than in normal lysine stocks. The implications for plant breeding are discussed.

BIOMEDICAL SCIENCES, APPLIED STUDIES

REFER ALSO TO CITATION(S) 40603

RADIATION EFFECTS ON BIOCHEMICALS

IN VITRO

REFER ALSO TO CITATION(S) 40363

40357 (ERDA-tr—241, pp 145-147) **Change in K^+ ion transport through phospholipid membranes in the presence of radiation-induced peroxidation.** Kravtsov, G.M.; Deev, L.I.; Karagodin, V.P.; Kudryashov, Yu.B. (Moscow State Univ.). 1976. Translated from Radiobiologiya; 16: No. 5, 762-764(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

In this work, we determined the role of intermediate products of peroxidation of phospholipids (peroxides) of phosphatidylcholine synthetic membranes in the increased liposome permeability for K^+ ions which is observed with irradiation. Intensification of passive diffusion of ions through membranes with irradiation of liposomes may be related to increased rate of phospholipid "flip-flop," or formation of additional "pores" with optical isomerization of phospholipids. As mentioned by these authors, the intensity of both processes increases with peroxidation of fatty acid radicals (residues) of phospholipids.

40358 (AD-A—028306) **Oxidation of pesticides by ozone and ultraviolet light. Final report.** Mauk, C.E.; Prengle, H.W. Jr.; Payne, J.E. (Houston Research, Inc., Tex. (USA)). Jul 1976. Contract DAAG53-76-C-0089. 73p. (HRI—7206). NTIS $4.50.

This work was undertaken to establish the feasibility of the oxidation destruction in water of five pesticides: malathion, Baygon, Vapam, pentachlorophenol, and DDT, by ozone with ultraviolet light. Each separate pesticide was treated by ozone with various combinations of ultraviolet intensities and temperatures in a sparged stirred tank reactor. Not only was the pesticide destroyed, as indicated by gas chromatographic analysis, but also the total organic content of the water, with contributions from the pesticide and from intermediate oxidation products, was reduced to the limit of detectability. A mathematical model was developed, and constants were calculated from the data to characterize the reactions. Data resulted which will permit the design of prototype treatment equipment to remove pesticide from potable water or from effluent. (GRA)

IN ANIMALS

40359 (ERDA-tr—241, pp 12-17) **Effect of x-radiation on activity of adenosine triphosphatases of plasma membranes and other subcellular liver fractions.** Ryskulova, S.T.; Ivashchenko, A.T. (Inst. of Experimental Biology, Alma Ata, USSR). 1976. Translated from Radiobiologiya; 16: No. 5, 652-656(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

Whole-body irradiation of rats, in a dosage of 800 R x-rays, induced significant impairment of function of ATPases of plasma membranes (PM), nuclear, mitochondrial, supernatant fractions and liver homogenate, which are stimulated by Na^+, K^+, Mg^{++}, and HCO_3^- ions. Activity of Na^+, K^+, and HCO_3^- ATPases diminished in all of the examined fractions and homogenate; this was more marked in PM and the supernatant fraction. Mg^{++}-ATPase activity showed primarily an increase, or else remained at the control level.

IN MAN

REFER ALSO TO CITATION(S) 39554

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

40360 (ERDA-tr—241, pp 85-90) **Effect of DNA on survival of irradiated tumor and normal cells in vitro.** Bukhtoyarova, Z.M. 1976. Translated from Radiobiologiya; 16: No. 5, 712-716(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

Addition of normal tissues to the medium elicited significant inhibition of growth of nonirradiated and particularly irradiated (LD_{30} and LD_{70}) HEp-2 tumor cells. With addition of isologous DNA (from HEp-2 cells), growth of nonirradiated cells was stimulated. Addition of normal tissue DNA to normal cultures of HAC (human amniotic cells) and CMH (cynomolgus monkey heart cells) after irradiation (LD_{70}) showed that the DNA preparations had different effects; the effectiveness of the latter is discussed in relation to the extent to which interaction between cell and preparation DNA is homologous.

40361 **Effects of tumor-like assay conditions, ionizing radiation, and hyperthermia on immune lysis of tumor cells by cytotoxic T-lymphocytes.** Harris, J.W. (Univ. of California, San Francisco). *Cancer Res.;* **36**: 2733-2739(Aug 1976).

Cytotoxic T-lymphocytes (CTL's) harvested from mixed splenic lymphocyte cultures (DBA/2 + C57BL) were tested for their ability to lyse allogeneic P815 mastocytoma cells under various tumor-like assay conditions, with or without previous exposure to ionizing radiation or hyperthermia (43°). There was little or no decrease of immune cytolysis when CTL's were assayed by ^{51}Cr release under tumor-like conditions (plateau-phase target cells, low pH, or anoxia) or after irradiation, but cytolytic activity was greatly reduced when CTL's were exposed to heat; 45 min of hyperthermic treatment decreased activity by greater than or equal to 99 percent while reducing the apparent cell viability (as indicated by trypan blue exclusion) by only 30 percent. When the P815 target cells rather than the CTL's were exposed to heat, their susceptibility to immune lysis was not affected even after treatment times that were lethal to the tumor cells. Despite the dissimilar heat sensitivities of CTL and P815 cells, the dose-response curves for inhibition of protein synthesis by heat, as indicated by [^{3}H]leucine incorporation, were similar for both cell types; neither the depression of protein synthesis in heated CTL's nor the decreased cytolytic ability of these cells was reversed within 3 hr. When irradiated or heated 2815 cells were incubated with CTL's, the resulting survival curves were always additive, indicating that neither irradiation nor heat treatment affected the susceptibility of the tumor cells to immune attack. The extreme heat sensitivity of cytotoxic T-lymphocytes raises important questions about the possible effects of hyperthermic treatment on the immune competence of cancer patients.

40362 **Single-strand scission and repair of DNA in mammalian cells by bleomycin.** Iqbal, Z.M.; Kohn, K.W.; Ewing, R.A.G.; Fornace, A.J. Jr. (National Cancer Inst., Bethesda, MD). *Cancer Res.;* **36**: 3834-3838(Oct 1976).

DNA single-strand breakage by bleomycin treatment of cultured mammalian cells was demonstrated by the method of alkaline elution. Elution patterns from treated L1210 cells indicated that part of the DNA was extensively broken while the remainder was affected to a lesser degree. This biphasic effect, which was less prominent in human fibroblasts, may reflect a selective sensitivity either of part of the cell population or of part of the DNA within individual cells. In both cell types, the DNA damage was at least partially repaired upon incubation of the cells after removal of drug. Bleomycin did not inhibit the rejoining of X-ray-induced single-strand breaks. The production and repair of DNA single-strand breaks after bleomycin treatment were the same in normal human and xeroderma pigmentosum fibroblasts, indicating that these events do not require the excision endonuclease that appears to be defective in these ultraviolet light-sensitive xeroderma cells.

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

40363 **Minireview: excision repair of DNA base damage.** Cerutti, P.A. (Univ. of Florida, Gainesville). *Life Sci.;* **15**: No. 9, 1567-1575(May 1974).

Exposure of cells to exogenous physical and chemical agents can result in damage to the DNA bases. DNA damage can lead to mutation, malignant transformation and cell death and may possibly be involved in cellular aging. Structurally related base modifications are expected to have similar biological effects regardless of the agent responsible for their formation. The biological effects may be a consequence of the local distortion of the DNA conformation by the lesion rather than of the chemical properties of the modified base per se. It may be useful, therefore, to classify DNA base damage according to its effect on DNA conformation. Several "repair endonucleases" have been characterized from bacteria while the search for the corresponding mammalian enzymes is only beginning. The second, probably less specific step, is the exonucleolytic degradation of the damaged portion of the DNA leading to the removal of the damaged residue. In E. coli the removal of both cyclobutane-type photodimers and γ-ray products of the 5,6-dihydroxy-dihydrothymine type is accomplished by the 5′ yields 3′ exonuclease associated with polymerase I. All three E. coli polymerases appear to participate in the rebuilding of the degraded portion of the DNA. Studies on the corresponding enzymes in mammalian cells have been initiated. The last step of excision repair involves the sealing of a phosphodiester bond of the DNA backbone and is accomplished by the enzyme polynucleotide ligase in bacterial and mammalian cells.

40364 **Superoxide dismutase and the oxygen enhancement of radiation lethality.** Misra, H.P.; Fridovich, I. (Duke Univ., Durham, NC). *Arch. Biochem. Biophys.;* **176**: 577-581(1976).

Escherichia coli B were more susceptible to radiation lethality and showed a greater oxygen enhancement ratio when exposed in dilute suspension (1 x 10^5 cells/ml) than when exposed in dense suspensions (1 x 10^9 CELLS/ml). The oxygen enhancement, seen with dilute suspensions, was diminished by superoxide dismutase, catalase, mannitol, or histidine. Heat-denatured superoxide dismutase was without effect. The results are interpreted as indicating a role for O_2^- plus H_2O_2 in the oxygen enhancement of radiation lethality, and a scheme is proposed which is consistent with the observations.

40365 (ERDA-tr—241, pp 148-150) **Effects of radioprotective agents on endogenous serotonin content and radiosensitivity of isolated cells. Experiments on cells of Ehrlich's ascites tumor and E. coli B. bacteria.** Goncharenko, E.N.; Gorskaya, T.G.; Gusareva, E.V.; Konstantinova, M.M.; Panyushkina, N.V. (Moscow State Univ.). 1976. Translated from Radiobiologiya; 16: No. 5, 764-767(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

A number of facts have now been obtained indicating that endogenous amines (serotonin, histamine, catecholamines) are involved in modifying radiosensitivity of mammals under the influence of radioprotective agents. In this regard, the question arose of the significance of these amines in determining cellular radiosensitivity as well, and in particular under the influence of antiradiation agents. Our objective was to investigate the levels of endogenous serotonin in isolated tumor and bacterial cells. The obtained data indicate that, in the case of increased radioresistance resulting from incubation of isolated cells with a radioprotector, there is elevation of endogenous serotonin level. The degree of increase in radioresistance and serotonin content of the cells are interrelated: with decline of endogenous serotonin level, radioresistance of the cells diminishes. If we also take into consideration the data obtained from assaying thiols in EAT and E. coli B. cells in the presence of enhanced radioresistance, we can conclude that cellular radioresistance, like radioresistance of mammals, is related to the levels of a number of biologically active substances which have radioprotective properties.

40366 (ERDA-tr—241, pp 55-61) **Effects of ionizing radiation on conjugation of E. coli K-12 (HfrxF$^-$) bacteria. Report 1. A mathematical model.** Troitskii, N.A.; Dromashko, S.E. (Inst. of Genetics and Cytology, Minsk). 1976. Translated from Radiobiologiya; 16: No. 5, 687-692(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

The authors discuss a mathematical recombination model of conjugation in E. coli K-12 bacteria, in which integration of donor markers in the recipient chromosome is considered as a Markovian process. Several parameters are introduced, which permit evaluation of the effects of ionizing radiation on incidence of incorporation in the recombinant of the beginning of the donor's transmitted chromosome, probability of its transfer, and incidence of integration of donor and recipient markers.

40367 **Biological and biochemical studies on the inactivation of avian oncoviruses by ultraviolet irradiation.** Bister, K.; Varmus, H.E.; Stavnezer, E.; Hunter, E.; Vogt, P.K. (Univ. of Southern California, Los Angeles). *Virology:* 77: No. 2, 689-704(Apr 1977).

The effects of ultraviolet (uv) irradiation on transforming and replicating capacities of avian oncoviruses and on the synthesis of virus specific products after infection with irradiated virus were studied. Different strains of nondefective avian sarcoma viruses were inactivated at the same rate following single-hit kinetics. The 37 percent survival dose D_{37} (1/e) was 736 erg mm^{-2} on average. A comparison of the inactivation kinetics in a focus assay (transforming capacity) and an infectious center assay (replicating and transforming capacity) showed no partial inactivation of the virus genome; focus and infectious center formation were inactivated at the same rate. Similar results were obtained when the replicating capacity of the avian sarcoma virus was measured in a plaque assay. The rates of inactivation of avian sarcoma virus assayed in focus and infectious center tests on chick embryo fibroblasts expressing or not expressing chicken helper factor, on chick embryo cells preinfected with RAV-1, and on Peking duck cells were identical. Nondefective avian sarcoma virus and deletion mutants of avian sarcoma virus defective for replication or transformation were inactivated at the same rate. Biochemical analysis of the DNA extracted from a Japanese quail tumor cell line (QT-6) 26 hr after infection with irradiated avian sarcoma virus strain B77 showed a decrease of total virus specific DNA and of full-length covalently closed circular (form I) viral DNA synthesis with increase of the uv dose. Virus-specific RNA synthesis, measured by hybridization of labeled RNA extracted from chicken embryo fibroblasts infected with irradiated virus to viral DNA, and particle production, assayed by uridine incorporation, were also inhibited with increasing uv dose. The inactivation rates for virus-specific DNA and RNA synthesis and for particle production were very similar, but lower than the rate for the loss of infectivity.

VACCINE PREPARATION AND OTHER APPLICATIONS

40368 (AD-A—029680) **Effect of gamma rays on microorganisms and chemicals in water, wastewater, and sludge. Final report, 1 Jul 1971—31 Dec 1975.** Woodbridge, D.D.; Cooper, P.C. (Florida Inst. of Tech., Melbourne (USA). Univ. Center for Pollution Research). 6 Feb 1976. Contract DAAK02-71-C-0296. 178p. NTIS $7.50.

Gamma rays have been found to be effective in destroying certain chemical structures and in killing both pathogenic and nonpathogenic bacteria. A synergistic effect has been discovered when aqueous solutions are either pretreated with chlorine or when air or oxygen are bubbled through the solutions during irradiation. The data indicates that the effectiveness of the irradiation process is dependent on the concentration of solids in the aqueous solution. (GRA)

RADIATION EFFECTS ON PLANTS

BASIC STUDIES

40369 (TID—26113-P2) **Enterprise Forest. Volume II. Radioecological studies.** Zavitkovski, J. (ed.). (Forest Service, Rhinelander, Wis. (USA). North Central Forest Experiment Station). 1977. 220p. Dep. NTIS $7.75.

Separate abstracts were prepared for the 20 sections included in this report. (HLW)

40370 (TID—26113-P2, pp 1-8) **Radiation patterns and dosimetry in the Enterprise Radiation Forest.** Salmonson, B.J. 1977. In Enterprise Forest. Volume II. Radioecological studies.

Gamma-radiation exposure was monitored by lithium fluoride thermoluminescent dosimeters placed in such a manner that both horizontal and vertical exposure distributions could be determined around the 10,000-Ci ^{137}Cs source. Radiation attenuation by tree trunks was 50 percent or greater near the source, but, beyond 40 to 50 m from the source, there was no significant difference between exposures on the side facing the source vs. the side away from the source. At distances beyond 20 m, radiation attenuation in the Enterprise Radiation Forest was greater than in similar experiments at the Savannah River Plant and Brookhaven National Laboratory and less than at El Verde, Puerto Rico, Rain Forest.

40371 (TID—26113-P2, pp 9-17) **Temperature and moisture regimes in the Enterprise Forest, 1970—1973.** Crow, T.R. (Inst. of Tropical Forestry, Rio Piedras, Puerto Rico); Buech, R.R. 1977. In Enterprise Forest. Volume II. Radioecological studies.

Within the Enterprise Radiation Forest, measurements of ambient air temperature, humidity, and precipitation were taken from 1970 through 1973. Temperature and moisture stresses that could alter the responses of organisms to gamma radiation were not evident during irradiation (1972) or during the recovery year 1973. Changes in microclimatic regimes as a result of the destruction of vegetation by gamma radiation were also assessed. Although differences in temperature and vapor-pressure deficit (VPD) were small when considering monthly means, mean maximum and mean minimum temperature and standardized plots of mean daily temperature and mean daily VPD indicated greater extremes in the newly created open environment than under the forest canopy. These relationships parallel those reported in comparisons of open environments to forested environments.

40372 (TID—26113-P2, pp 19-24) **Light distribution under gamma-irradiated aspen and maple-aspen-birch forests in the Enterprise Radiation Forest.** Zavitkovski, J. 1977.

In Enterprise Forest. Volume II. Radioecological studies.

Light distribution under canopies of aspen and maple-aspen-birch forests was determined before (1970 and 1971), during (1972), and after (1973 and 1974) the communities had been gamma-irradiated. No changes in light intensity were found during the first 4 months of irradiation (from May to August). In September 1972 light under canopies of both forest types increased 5 to 64 percent from the radiation source to a distance of 35 to 40 m. After the irradiation was terminated, a drastic increase in light occurred in 1973 and 1974. The August 1973 and 1974 light values under the aspen canopy were 80 to 300 percent higher and those under the maple-aspen-birch canopy were 150 to 800 percent higher than before irradiation. Responding primarily to increased light, the newly established vegetation in the semidevastated zone resembled in many respects the early successional stages observed on recent clear-cutting, thus confirming findings of other radioecologists.

40373 (TID—26113-P2, pp 25-34) **Effects of chronic gamma radiation on the lichen Parmelia sulcata Tayl. in the Enterprise Radiation Forest.** Erbisch, F.H. (Michigan Technological Univ., Houghton). 1977.

In Enterprise Forest. Volume II. Radioecological studies.

Within the Enterprise Radiation Forest, the foliose lichen Parmelia sulcata Tayl. exhibited radiation damage. Only those lichens which received in excess of 100 krad manifested damage. The damage was evidenced as a lifting and subsequent breaking of lobes, a coalescing of fungal hyphae, a formation of a brown pigment by the coalescing hyphae, a distortion of the chloroplastid of the algal component, and eventual death of the lichen. The radiation also affected thallus growth by slowing it and rhizinae branching by increasing the number of branches. Damage was not manifested until the late spring (June) of the year following radiation. Apparently P. sulcata is able to maintain itself until conditions are favorable for growth, after receiving a large dose of gamma radiation. Under favorable growth conditions, the lichen cannot carry out its normal

growth functions and deteriorates. Although environmental changes did occur within the forest, evidence obtained indicates that gamma radiation was the principal factor affecting the lichens.

40374 (TID—26113-P2, pp 35-42) **Effects of gamma radiation on biomass production of ground vegetation under broadleaved forests of northern Wisconsin.** Zavitkovski, J. (Colorado State Univ., Fort Collins); Salmonson, B.J. 1977.

In Enterprise Forest. Volume II. Radioecological studies.

Effects of gamma irradiation (10,000-Ci ^{137}Cs source) for one growing season on biomass production of ground vegetation under northern Wisconsin aspen and maple-aspen-birch forests and on an abandoned logging road were evaluated during and 1 year after irradiation. No significant changes in production were determined during the irradiation year. One year later three distinct zones—semidevastated, herbaceous, and original forest—developed along the radiation gradient. Biomass production under forest canopies decreased significantly in the semidevastated zone, increased significantly in the herbaceous zone (primarily responding to additional light), and remained unchanged under the original forest. Logging-road vegetation responded similarly, but the changes were restricted within higher radiation doses. At comparable levels of radiation, production of species of the logging-road vegetation was affected less than that of species under forest canopies. Such a trend was predictable from the generally smaller interphase chromosome volumes of the species on the logging road and from their ability to survive in severe habitats.

40375 (TID—26113-P2, pp 43-48) **Response of a forest ecotone to ionizing radiation.** Murphy, P.G. (Michigan State Univ., East Lansing); Sharitz, R.R.; Murphy, A.J. 1977.

In Enterprise Forest. Volume II. Radioecological studies.

Compositional and structural characteristics of a forest ecotone in northern Wisconsin, including aspen and maple-birch forest types and the intervening midecotone, were studied before and after irradiation. Irradiation occurred during the summer of 1972. By the summer of 1973, the density of viable tree seedlings at 10 m from the radiation source was substantially reduced in all three areas relative to the preirradiation densities of 1971. As of 1975, reestablishment of tree seedlings had been prevented by the vigorous development of ground vegetation at 10 m. At 20 m, the density of seedlings in the three areas increased during the period between 1971 and 1973 in response to the partially opened canopy. The overall density of seedlings of Populus tremuloides and Acer rubrum increased markedly in the three areas, and P. tremuloides invaded some areas in which it had not been found before irradiation. By 1974 many of the seedlings at 20 m had reached the sapling size class. Viable trees greater than 2.5 cm dbh were eliminated at 10 m in all three areas by June 1974 and were reduced in density at 20 m. Leaf-litter production was reduced by up to 92 percent at 10 m and 62 percent at 20 m during the period between 1971 and 1973 in the irradiated areas. The reduction was greatest in the aspen area. Leaf-litter reduction in the midecotone and maple-birch areas was less severe, averaging 50 percent at 10 m and 24 percent at 20 m.

40376 (TID—26113-P2, pp 49-62) **Structural and floristic changes caused by gamma radiation in understory vegetation of two forest types in northern Wisconsin.** Zavitkovski, J. 1977.

In Enterprise Forest. Volume II. Radioecological studies.

Structural and floristic changes of the understory vegetation of gamma-irradiated aspen and maple-aspen-birch (MAB) communities in northern Wisconsin were quantified by comparing the pre- and postirradiation floristic composition and vegetational cover. A size-dependent radiosensitivity was determined among three vegetational strata, the tall shrubs being the most sensitive, low shrubs intermediate, and herbs the most resistant. Corylus cornuta, whose nuclear characteristics indicated that it could be resistant, was very sensitive and was completely eliminated at exposures of 500 r/20-hr day or higher. The cover of Rubus strigosus, minimal before irradiation, increased manifold and accounted for most of the shrub cover 2 years after the conclusion of irradiation. Among herbs, Carex pensylvanica and Luzula acuminata were very resistant, and Trillium grandiflorum, Aralia nudicaulis, Oryzopsis asperifolia. and Clintonia borealis were very sensitive. The herbaceous stratum of the aspen type appeared more resistant than that of the MAB. This difference apparently resulted from differences in floristic composition of the two communities.

40377 (TID—26113-P2, pp 63-67) **Biomass and production regressions for trees and woody shrubs common to the Enterprise Forest.** Crow, T.R. (Inst. of Tropical Forestry, Rio Piedras, Puerto Rico). 1977.

In Enterprise Forest. Volume II. Radioecological studies.

Regressions for estimating biomass and biomass increment are listed for seven woody species common to the Enterprise Forest. The data on which these regressions are based are also made available. Both types of information are necessary for assessing existing regressions and developing new regressions for broader applications.

40378 (TID—26113-P2, pp 69-78) **Effects of gamma radiation on the biomass structure of the arboreal stratum in a northern forest.** Crow, T.R. (Inst. of Tropical Forestry, Rio Piedras, Puerto Rico). 1977.

In Enterprise Forest. Volume II. Radioecological studies.

In 1972 an area within the Enterprise Radiation Forest was subjected to a growing-season exposure of gamma radiation from a 10,000-Ci ^{137}Cs source. Structural changes in woody vegetation caused by ionizing radiation were quantified by measuring changes in the amounts and distribution of biomass. Measurable effects immediately after irradiation were confined to an area within 10 to 15 m from the source; this represented an exposure rate greater than 200 r/day and cumulative exposure in excess of 20 kr. These effects included total shrub mortality at 5 m, 70 to 90 percent reductions in shrub biomass at 10 m, very slight reductions in shrub biomass at 15 m, and an early release of tree and shrub leaf litter within 15 m of the source. Responses to the treatment were more definitive in 1973 and 1974. Ionizing radiation reduced the biomass of low shrubs within 15 m from the source (greater than 135 r/day), but this reduction did not continue beyond 1973 because of ingrowth. Declines in biomass of high shrubs continued into 1974 out to a distance of 30 m (greater than 40 r/day). The result was the spatial and temporal development of a shrub community with a lower profile in response to radiation. Although gross changes in the biomass structure of the tree stratum did not occur until 1973 and 1974, radiation-induced changes in productivity were immediate.

40379 (TID—26113-P2, pp 79-90) **Radiosensitivity and recovery of tree crowns in a gamma-irradiated northern forest community.** Buech, R.R. 1977.

In Enterprise Forest. Volume II. Radioecological studies.

Crown mortality was observed on 13 tree species in a gamma-irradiated forest community located near Rhinelander, Wis. Observations at the end of the first (1973) and second (1974) postirradiation growing seasons are presented for each species. Crown mortality was most severe during 1973 for Acer rubrum, A. saccharum, Ostrya virginiana, Populus tremuloides, Prunus serotina, Quercus rubra, and Ulmus americana. For some species, however, crown mortality was most severe during 1974. These were Betula alleghaniensis, B. papyrifera, Tilia americana, and possibly Fraxinus americana and F. nigra. These differences in year of primary response are explained on the basis of bud differentiation and mortality. The most resistant species were A. saccharum, O. virginiana, and Populus tremuloides, and the most sensitive were T. americana and U. americana. Others were intermediate in sensitivity. Taken collectively, exposures less than 2 or 3 kr did not seriously affect crowns of most species, whereas exposures exceeding about 40 kr were lethal to the crowns of all tree species. The observed zonation of tree mortality closely approximated predictions published by others except for underestimating the resistance of A. saccharum and overestimating the resistance of T. americana, F. americana, and Prunus serotina. Not surprisingly, the tree stratum of the northern forest community was found to be more radiosensitive than lichen, grassland, or herbaceous communities in other irradiation studies.

40380 (TID—26113-P2, pp 91-106) **Tree-shoot elongation patterns in a gamma-irradiated northern forest community.** Buech, R.R. (North Central Forest Experiment Station, St. Paul); Salmonson, B.J. 1977.

In Enterprise Forest. Volume II. Radioecological studies.

Shoot elongation in the upper crowns of seven tree species was studied in a gamma-irradiated northern forest community near Rhinelander, Wis. Observations on the pattern and duration of shoot elongation are presented for the irradiation (1972) and postirradiation (1973) growing seasons. The gymnosperm Abies balsamea was the most radiosensitive species. Significant alteration in pattern and duration was observed in 1973 at exposure rates of 4 to 25 r/20-hr day; 31 r/20-hr day was lethal. At the other extreme, 116 r/20-hr day produced no significant effects on Acer saccharum shoot elongation pattern or duration. Acer rubrum, Betula papyrifera, Populus tremuloides, Quercus rubra, and Tilia americana were intermediate in radiosensitivity. Observed responses to radiation were alteration in the elongation pattern, suppression of internodal elongation, and death. Effects of the 1972 growing-season exposure were most obvious in the subsequent growing seasons. Retardation of initial elongation was characteristic of all species. Cessation of elongation was variable, even within species (e.g., P. tremuloides). The results suggest that bud differentiation and morphology and dependency on food reserves contributed to the lag in manifestation of radiation damage. The resultant crown characteristics are described and explained.

40381 (TID—26113-P2, pp 107-118) **Patterns of radial and shoot growth of five tree species in a gamma-irradiated northern Wisconsin forest.** Zavitkovski, J. (North Central Forest Experiment Station, St. Paul); Buech, R.R.; Rudolph, T.D.; Bauer, E.O. 1977.

In Enterprise Forest. Volume II. Radioecological studies.

Patterns of radial and shoot growth of Abies balsamea, Acer rubrum, A. saccharum, Betula papyrifera, and Populus tremuloides

were observed before (1970) and during (1972) gamma-irradiation of forest communities in the Enterprise Radiation Forest. Measurements were made during the growing season along the radiation gradient, and year days (YD) of 10, 25, 50, 75, and 90 percent of total growth were obtained by interpolation. The experimental area was divided into an "affected" and a "no-effect" zone. The boundary of the affected zone coincided with radiation exposures that effectively reduced the 1972 radial growth of a given species in comparison to the preirradiation growth. In 1970 and in the no-effect zone in 1972, shoot growth of the four broadleaved species started and terminated earlier than the radial growth. In A. balsamea the radial growth started earlier and terminated later than the shoot growth. In all five species, duration of radial growth was significantly longer than that of shoot growth. Radial growth of A. rubrum, A. saccharum, and B. papyrifera started significantly earlier in 1972 than in 1970, but no difference between years was found in the early-starting A. balsamea and P. tremuloides. In contrast, shoot growth of all five species started earlier in 1970 than in 1972. It is suggested that temperature regimes during the early developmental stages were probably responsible for the difference. In the affected zone in 1972, the radiation depressed radial growth and changed its normal pattern in all five species.

40382 (TID—26113-P2, pp 119-126) **Phenology of selected herbaceous species of northern Wisconsin deciduous forests and forest roads.** Zavitkovski, J. 1977.

In Enterprise Forest. Volume II. Radioecological studies.

Vegetative and reproductive phenophases were observed from 1970 to 1974 on 30 native and 8 introduced herbaceous species growing under deciduous forests and on an abandoned logging road in the Enterprise Radiation Forest in northern Wisconsin. Forest herbs started growing in the same order each year, but logging-road herbs varied. Growth initiation was more variable in the early-starting than in the late-starting species. In most years logging-road herbs started growth a few days earlier than forest herbs. Initiation of flowering of the 38 species was bimodal, culminating around mid-May for forest species and around mid-July for logging-road species. In general, the annual start of flowering varied less than the start of vegetative growth. Duration of flowering of most species was variable, however. Seed ripening times varied strikingly among species, ranging from 11 days for Taraxacum officinale to 101 days for Iris versicolor. Seeds of forest herbs took longer to ripen than those of logging-road species. On the basis of growth initiation of the 6 earliest species, spring arrival in 1970 to 1974 differed by 26 days and appeared to be related to snow disappearance. The growing season of most species paralleled cumulative current-year (May—July) and last-year (August—September) precipitation. Multiple regression analyses between precipitation and average length of growing season explained 87 percent of the total variation for forest herbs and 69 percent of that for logging-road herbs.

40383 (TID—26113-P2, pp 127-139) **Effects of gamma radiation on vegetative and reproductive phenology of herbaceous species of northern deciduous forests.** Zavitkovski, J. 1977.

In Enterprise Forest. Volume II. Radioecological studies.

Vegetative and reproductive phenology of 38 herbaceous species of northern deciduous forests and forest roads were observed for 5 years, before (1970 and 1971), during (1972), and after (1973 and 1974) gamma irradiation. During the preirradiation years the occurrence of key vegetative and reproductive phenophases was very uniform throughout the area. This uniformity was upset by irradiation. In 1972 signs of senescence appeared earlier in most plants of the high-radiation zone (greater than or equal to 300 r/day) than in those outside that zone. In 1973 initiation of growth and completion of leaf growth of most plants was delayed by several weeks in the high-radiation zone. In both years the length of growing season was significantly shortened; this was also reflected in reduced biomass production. Vegetative development of surviving plants normalized in 1974. In 1972 flowering of forest herbs (which as a group flower early in the spring) was not affected by radiation, but that of summer-flowering logging-road herbs was delayed because the critical radiation doses were reached at that time. In 1973 all five flowering phenophases of the logging-road herbs were delayed about 3 weeks in the high-radiation zone. Normalization of reproductive phenophases became evident in 1974.

40384 (TID—26113-P2, pp 141-165) **Tree phenology in a gamma-irradiated northern forest community.** Buech, R.R. (North Central Forest Experiment Station, St. Paul); Salmonson, B.J. 1977.

In Enterprise Forest. Volume II. Radioecological studies.

The phenology of eight tree species was studied before, during, and after exposure to ^{137}Cs gamma radiation in a northern forest community near Rhinelander, Wis. Observations on nonirradiated trees are presented for the 1970 to 1974 growing seasons for both vegetative and reproductive phenophases. The unusual temperatures recorded in several years were evident in the phenological record of many species. Graphs of vegetative and reproductive phenophases, based on mean year day (1970 to 1974), illustrate interspecific differences in phenological progression. During the irradiation (1972) and postirradiation (1973 to 1974) growing seasons, trees located within the effective radiation range responded with abnormal phenological development. The degree and type of abnormality depended on the radiation exposure and species. The gymnosperm Abies balsamea was the most radiosensitive species in that exposures of 25, 27, and possibly 4 r/20-hr day altered their phenology and an exposure of 31 r/20-hr day and above was lethal. The most radiosensitive angiosperm was Tilia americana, in which phenological alteration was observed at 15 r/20-hr day in 1973 and as low as 6 r/20-hr day in 1974. One of two trees exposed to 66 r/20-hr day died. In contrast, exposures up to 116 r/20-hr day did not alter the phenology of Acer saccharum, making it the most resistant among species studied. Other species were intermediate in radiosensitivity. The effect of radiation on tree phenology was small during the irradiation growing season and consisted primarily of premature leaf coloration and fall for trees receiving substantial exposures.

40385 (TID—26113-P2, pp 185-188) **Increase in radiosensitivity with increase in age of Populus tremuloides seed.** Salmonson, B.J. (Colorado State Univ., Fort Collins). 1977.

In Enterprise Forest. Volume II. Radioecological studies.

Populus tremuloides seeds from one tree were irradiated with a 260-Ci ^{137}Cs gamma source to exposures of 0.47, 0.94, 1.4, 1.8, 3.7, 7.5, 15, 22, 30, 45, and 60 kr at increasing time intervals after seed collection. Two methods of seed storage were used prior to irradiation, refrigerator storage at 5°C and freezer storage at -19°C with vacuum desiccation. Gamma radiation had no effect upon germination percentage. However, marked decreases in the LD/sub 50-30/ of Populus tremuloides seedlings, grown from seed that was gamma irradiated at increasing time intervals after seed collection, indicated that the seed radiosensitivity increases with increasing age of the seed. Seed storage under vacuum desiccation in a freezer at -19°C prolonged the viable storage life of the seed over refrigerator storage.

40386 (TID—26113-P2, pp 189-195) **Gas exchange, dry weights, and chlorophyll contents of Populus tremuloides seedlings grown from gamma-irradiated seeds.** Salmonson, B.J. (Colorado State Univ., Fort Collins); Zavitkovski, J. 1977.

In Enterprise Forest. Volume II. Radioecological studies.

Photosynthesis and respiration rates of Populus tremuloides seedlings grown from seeds acutely irradiated with gamma rays (at levels of 0, 0.47, 0.94, 1.8, 3.7, 7.5, and 15 kr) were measured using a closed system and infrared (IR) gas analyzer. Dry weights of seedling roots and shoots and chlorophyll contents were also determined. In general, gamma irradiation of seed had little effect on subsequent gas-exchange processes in the plant. Net photosynthesis and dark respiration rates of the seedling at any radiation level were not significantly different from those of the control group. Pooled net photosynthesis of all irradiated seedlings was nonsignificantly lower than that of the control seedlings. The data suggested a slight stimulation in dry-matter production of shoots by low levels of gamma radiation. At the highest levels of radiation, shoot dry weight was significantly reduced. Root production displayed a pattern similar to that of shoots. No trends different from controls were evident in the shoot/root ratios. Total chlorophyll concentrations of the seedling increased over the controls by radiation treatment. Age and radiation effects were evident in the chlorophyll a/b ratios. The chlorophyll a/b ratios decreased with age in both the control and treatment groups. Although in seedlings 39 through 46 days old chlorophyll a/b ratios were higher in the control, chlorophyll a/b ratios were significantly higher in the treatment seedlings at 68 days. Changes in chlorophyll a were primarily responsible for this change.

40387 (TID—26113-P2, pp 197-206) **Effects of gamma radiation on a northern forest ecosystem: a summary.** Zavitkovski, J. 1977.

In Enterprise Forest. Volume II. Radioecological studies.

This chapter summarizes results of radioecological studies conducted in the Enterprise Radiation Forest in northern Wisconsin between 1969 and 1975. The chapter is intended as a quick reference to the detailed work by individual participants in the project. In addition, predicted and observed radiation effects are compared. Vegetation zones which developed around the radiation source and their positions correspond closely to the predicted zonation. The successive zones, starting with the most resistant, were dominated by herbs and lichens, shrubs and resistant broadleaved trees, most broadleaved trees, and finally the original northern forest, which differed from the previous zone by also having Abies balsamea. Compared to other forest ecosystems, the northern deciduous forest was more radioresistant than other deciduous forests of the temperate climate and about equally as resistant as a tropical rain forest. Herbaceous vegetation under forest canopies and on a logging road was more resistant than were other communities of herbaceous species including rock outcrop, old fields, and grassland.

40388 (ERDA-tr—241, pp 1-11) **Radiation aspects of the transcription problem.** Tokarskaya, V.I. (Inst. of Biological Physics, Pushchino, USSR). 1976. Translated from Radiobiologiya; 16: No. 5, 643-651(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

Various aspects of the problem of transcription in the irradiated organism are discussed on the present level of knowledge about metabolism of nuclear ribonucleic acids.

40389 (ERDA-tr—241, pp 44-49) **Radiosensitivity of photosynthetic systems of agricultural plants.** Ponomareva, R.P.; Zuev, N.D.; Kal'chenko, V.A. (Inst. of General Genetics, Moscow). 1976. Translated from Radiobiologiya; 16: No. 5, 678-682(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

A study was made of the effects of strontium-90 throughout the entire vegetation period on photosynthetic processes in potato, wheat, and bean plants under field conditions. It was established that, at the early stages of development (sprouts), there was a decline in chlorophyll content of the leaves of experimental plants, as compared to the control, with decrease in intensity of photosynthesis. As the plants advanced into the budding stage, the photosynthetic processes were restored. But, in irradiated plants, there was a change in distribution of photoassimilates in the organs, as manifested by decreased access of plastic substances into the developing fruit. All this affects processes of formation of plant harvest when vegetation takes place with chronic exposure to β-radiation.

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 39348, 39353, 40492, 40586

40390 (ERDA—77-29) **Eighth annual report of radiation exposures for ERDA and ERDA contractor employees.** (Environmental Research and Technology, Inc., Concord, Mass. (USA)). 1975. 49p. P 03/MF A01.

In 1968, the U.S. Atomic Energy Commission (AEC) established a program for reporting certain occupational radiation exposure information to a central radiation records repository maintained at the Union Carbide Computing Technology Center, Oak Ridge, Tennessee. Annual summaries (WASH-1350-R1 through WASH-1350-R6) were reported for the years 1968 to 1973 and included data on AEC contractor employees as well as employees of companies in the private sector licensed by the AEC. The 1974 data for what is presently ERDA and ERDA contractor employees are published in the ERDA 76/119 report. In January 1975, two new agencies, the Energy Research and Development Administration (ERDA) and the U.S. Nuclear Regulatory Commission (NRC) were formed and now share the responsibilities previously held by the AEC. Previous AEC licensees now report to NRC while the contractors report to ERDA. This report contains 1975 radiation exposure data for ERDA and ERDA contractor employees.

40391 (FDA—77-8013) **Mean active bone marrow dose to the adult population of the United States from diagnostic radiology.** Shleien, B.; Tucker, T.T.; Johnson, D.W. (Department of Health, Education, and Welfare, Rockville, Md. (USA)). Jan 1977. 42p. GPO.

Estimates, based on an empirical model and computer program (Ellis, Healy, Shleien and Tucker, HEW publication (FDA)76-8015), have been calculated and are presented on the mean active bone marrow dose to adults from diagnostic radiography, fluoroscopy, and dental radiography as practiced in the United States in 1970. The annual per capita mean active bone marrow dose in 1970 to adults from the above practices is estimated to have been 103 mrad; 77 percent, 20 percent, and 3 percent from radiographic, fluoroscopic and dental examinations, respectively. Examinations of the upper and lower abdomen contribute approximately 39 percent each to the total mean active bone marrow dose for adults; those of the pelvis, 4 percent; the thorax, 12 percent; and head and neck examinations (including dental) contribute about 6 percent. The per capita mean active bone marrow dose for various age groups is discussed. Contributions to the dose within a given age group from different examinations indicate that in the 15 to 34 year age group lumbar and lumbosacral spine examinations contribute most to the mean active bone marrow dose. Thereafter upper Gi series and barium enemas are the highest contributors. Mean active bone marrow doses for children are not estimated in this presentation due to insufficient data. However, the lower rate of use of diagnostic x rays (except dental) in children would reduce the annual per capita mean active bone marrow dose for the entire population to approximately a maximum of 77 mrads. The results may be viewed relative to several surveys of radiation doses from diagnostic radiology performed in other countries which reported annual per capita mean active bone marrow doses varying from 30 to 189 mrads for their entire populations, and with natural background for which the annual per capita whole body and bone marrow dose in the United States is approximately 130 and 86 mrads, respectively.

40392 (PB—255363) **Organ doses in diagnostic radiology.** Rosenstein, M. (Bureau of Radiological Health, Rockville, Md. (USA)). May 1976. Contract W-7405-ENG-26. 132p. (FDA/BRH—76/88; DHEW/PUBL/FDA—76/8030). Dep. NTIS $6.00.

There is considerable interest in the medical, radiological health, and public sectors for data that can be used easily to make estimates of organ doses that result from diagnostic radiology procedures within and among medical facilities. At these facilities the choices of technical parameters for the conduct of x-ray examinations impact significantly on patient dose. This report describes a system for obtaining such dose estimates. The techniques and data in the report were designed for general applicability and are the most complete and versatile treatment of the topic to date. While the organ doses tabulated apply to a limited number of routine procedures performed on a reference adult patient, the dose estimation methodology is completely general.

40393 (PB—259947) **Report of state and local radiological health programs. Annual report, 1973—1975.** Miller, L. (Bureau of Radiological Health, Rockville, Md. (USA)). Jul 1976. 73p. (FDA/BRH—77/6; DHEW/PUBL/FDA—77/8005). Q 04/MF A01.

Supersedes PB—246845.

The report is the fifteenth of a series based on data collected during fiscal year reviews of 53 state and local radiological health programs. The resources and activities of state and local radiological health programs are presented and summarized from data collected as of June 30, 1975. Summary data are included for fiscal years 1973 through 1975. Resources include data on personnel, funds, and equipment. The program activity areas are basic planning and administration, x-ray survey and control, environmental surveillance, radioactive materials, electronic products, and other radiological health activities. (GRA)

40394 **Film techniques in radiotherapy for treatment verification, determination of patient exit dose, and detection of localization error.** Haus, A.G. (Univ. of Chicago); Marks, J.E. *J. Appl. Photogr. Eng.;* **2**: No. 1, 11-16(Win 1976).

In patient radiation therapy, it is important to know that the diseased area is included in the treatment field and that normal anatomy is properly shielded or excluded. Since 1969, a film technique developed for imaging of the complete patient radiation exposure has been applied for treatment verification and for the detection and evaluation of localization errors that may occur during treatment. The technique basically consists of placing a film under the patient during the entire radiation exposure. This film should have proper sensitivity and contrast to the exit dose exposure range encountered in radiotherapy. In this communication, we describe (1) how various exit doses fit the characteristic curve of the film; (2) examples of films exposed to various exit doses; and (3) the technique for using the film to determine the spatial distribution of the absorbed exit dose; and (4) types of errors commonly detected. Results are presented illustrating that, as the frequency of use of this film technique is increased, localization error is reduced significantly.

40395 **Radiation pneumonitis producing respiratory failure.** Gracey, D.R. (Northwestern Univ. Medical School, Chicago). *Heart Lung;* **4**: No. 3, 452-455(1975).

A 51-year-old man was treated with radiation for a lesion of the lung. Three months later he experienced severe dyspnea and a diagnosis of radiation pneumonitis was made. Following treatment with supplemental oxygen and oral corticosteroids the patient improved. The beneficial effects of corticosteroids in reducing the severity of radiation effects on the lung are emphasized. (HLW)

40396 (PB—258167) **Recommendations on guidance for diagnostic x-ray studies in Federal health care facilities. Background report.** (Environmental Protection Agency, Washington, D.C. (USA)). Mar 1976. 40p. (EPA—520/4-76/002). NTIS $4.00.

One of the most significant aspects of good medical care is the use of x-rays to diagnose and define the extent of disease or physical injury. The per capita use of x-rays in medicine and dentistry has expanded rapidly in the United States due to wider availability of services, new equipment, and an increase in sophisticated diagnostic examinations. Although many procedures now produce less exposure per film, the increased number of procedures has increased the radiation exposure to the population. The most important factor in reducing radiation exposure is to eliminate clinically unproductive procedures. The factors involved in accomplishing this goal were examined by the Subcommittee on Prescription of Exposure to X-rays which was made up of physicians, dentists, and physicists from the three military services, the Veterans Administration, and the Environmental Protection Agency. (GRA)

40397 (PB—256678) **Dental exposure normalization technique 'DENT' instruction manual.** Crabtree, C.L.; Jameson, W.R. (Bureau of Radiological Health, Rockville, Md. (USA)). May 1976. 61p. (DHEW/PUBL/FDA—76/8042; FDA/BRH—76/92). NTIS $4.50.

The DENT Instruction Manual is designed for use by radiation control agencies in planning, initiating, and operating a successful dental exposure reduction program. The manual can serve as a guide and reference for conducting all phases of the program. It

details the assistance offered by the Bureau of Radiological Health, as well as the responsibilities and functions of participating radiation control agencies. (GRA)

40398 (PB—258159) **Program statement.** (Environmental Protection Agency, Washington, D.C. (USA). Office of Radiation Programs). May 1976. 52p. (EPA—520/7-76/007). NTIS $4.50.

The Environmental Protection Agency (EPA) has the responsibility to protect the health and welfare of man and the environment from adverse effects due to radiation exposure. This responsibility is implemented through the Agency's authorities which established EPA in a role to provide continuing Federal overview of radiation protection philosophies, policies and controls. This mandate is achieved by developing policies and controls based on the soundest available scientific and technical information, that satisfy the requirement and intent of the law, that are legally enforceable, and that reflect responsible public policy. (GRA)

40399 (PB—255629) **Radioiodine prediction model for nuclear tests. Final report.** Black, S.C.; Barth, D.S. (Environmental Protection Agency, Las Vegas, Nev. (USA). Environmental Monitoring and Support Lab.). Jun 1976. 44p. (EPA—600/4-76-027). NTIS $4.00.

Results of 14 experiments on the air-forage-cow-milk transfer of iodine-131 are summarized and used to develop prediction models for dose to the thyroids of infants. The models are based on data from various types of nuclear tests together with data from controlled experiments using contaminating aerosols. This provides a realistic foundation for the predictions and for adjusting the predictions to correct for some types of forage. Equations developed from these studies can be used to predict within a factor of 2 the infinite dose to a 2-gram thyroid from a single contaminating event where cows continue to ingest contaminated forage and the subject drinks 0.7 liters of milk per day. This dose, in rads, is equal to 0.37 times the peak exposure rate measured 1 meter above ground, or 0.07 times the integrated air concentration. For wet deposition, it is suggested that the predicted doses be increased by a factor of 10. An equation for pre-test prediction is also developed. Short-lived radioiodines and inhalation during effluent passage have a definite effect on the predicted doses. (GRA)

40400 (JPRS—67629) **Personal protection in the event of radiation accidents.** Gorodinskii, S.M.; Rokhlin, M.I.; Shcherbakov, V.L. 20 Jul 1976. Translation of Individualnaya Zashchita pri Radiatsionnykh Avariyakh, Moscow, n.d., p363-370. 11p. NTIS $3.50.

The report contains a description of a procedure for evaluating the protective efficiency of various types of personal protection equipment with respect to radioactive substances using a specially designed chamber. Descriptions are given of suits for use in radiation accidents. (GRA)

40401 (PB—258039) **Specific area gonad shielding. Recommendation for use on patients during medical diagnostic x-ray procedures. Technical report, 23 Jul 1976.** (Bureau of Radiological Health, Rockville, Md. (USA)). Aug 1976. 21p. (FDA/BRH—76/101). NTIS $3.50.

The objective of this document is to encourage the use of gonad shielding during x-ray procedures so that unnecessary radiation exposure of the reproductive organs of patients can be avoided. This in turn can lessen the likelihood of adverse genetic consequences in future generations as a result of today's medical radiologic practices. (GRA)

40402 Accuracy of diagnosis of cancer among autopsy cases: JNIH-ABCC population for Hiroshima and Nagasaki. Steer, A. (Radiation Effects Research Foundation, Hiroshima); Land, C.E.; Moriyama, I.M.; Yamamoto, T.; Asano, M.; Sanefuji, H. *Gann;* **67**: No. 5, 625-632(Oct 1976).

The accuracy of death certificate diagnoses of cancer in the fixed population of about 100,000 samples in Hiroshima and Nagasaki was determined for the period 1961 to approximately 1970 by comparison with autopsy findings. In general, when the death certificate listed cancer as a cause of death it was found at autopsy in a high proportion of cases. However, cancer was not always reported on death certificates, indicating that cancer occurs more frequently than recorded by official mortality statistics. Older persons, persons who die at home, and persons with certain cancers are more likely not to have cancer named on their death certificates. It is estimated that in the 10,749 deaths occurring at home or in hospital, there were 32 percent more deaths due to cancer than certified on death certificates (3,095 vs. 2,345) and for persons aged 70 or more dying at home it is estimated there were 55 percent more stomach cancer (269 estimated vs. 174 listed) and 244 percent more lung cancer (141 estimated vs. 41 listed) than were certified on death certificates. The death certificate is not a good source of information for cancer of the cervix because many cases of this disease are reported on death certificates as cancer of the uterus. This practice needs to be taken into account in the use of mortality data for cervical cancer in Japan.

40403 Benign tumors of the digestive tract among atomic bomb survivors, 1961-1970 Hiroshima. Yamamoto, T. (Atomic Bomb Casualty Commission, Hijiyama, Hiroshima); Kato, H.; Smith, G.S. *Gann;* **66**: No. 6, 623-630(15 Mar 1977).

The occurrence of benign tumors and diverticula of the digestive tract was investigated in an autopsy study of a fixed population of 100,000 samples in Hiroshima and Nagasaki. There were 664 benign tumors and 40 diverticula. Polyps were the most frequent tumor, were found more often in older people, occurred as single pedunculated well-differentiated adenomatous tumors, and most were less than 5 mm in greatest dimension. Larger polyps tended to have more atypism, but none showed definite premalignant change. No transition from benign to malignant polyps was seen. Polyps were found most frequently in the large intestine and in a large number (21 percent) and, when cancer of the large intestine was present, benign polyps were also found. Far more polyps are found when special intensive search is made for them. Comparison of the occurrence of benign polyps in different geographic areas must be adjusted for age and method of search as well as for other features such as histological type, dysplasia, etc. There was no evidence that the occurrence of benign tumors or diverticula was related to prior exposure to ionizing radiation.

40404 Radiation exposure and thyroid cancer. Greenspan, F.S. (Univ. California, San Francisco). *J. Am. Med. Assoc.;* **237**: No. 19, 2089-2091(9 May 1977).

There are abundant experimental and clinical data to associate radiation exposure and thyroid cancer. The incidence of thyroid cancer increases with increasing doses of thyroidal radiation from 6.5 rads to 1,500 rads, but higher doses tend to destroy the gland and are associated with hypothyroidism rather than cancer. The peak occurrence of thyroid tumors is between five and 30 years after exposure, but a person may develop thyroid tumors as long as 50 years after irradiation. Multiple thyroidal lesions or disorders, including adenomas, thyroiditis, and hypothyroidism as well as malignant neoplasms, can occur after radiation exposure. It is imperative, therefore, to study carefully all patients with a history of radiation exposure to the gland and to observe them carefully for life. Suggestions are made for the management of thyroid disease in these patients.

40405 Parotid carcinoma and posterior fossa schwannoma following irradiation. Report of a patient treated in infancy for benign ear disease. Sogg, R.L.; Nikoskelainen, E. (Stanford Univ., CA). *J. Am. Med. Assoc.;* **237**: No. 19, 2098-2100(9 May 1977).

A 23-year-old man had received irradiation for a benign ear problem at the age of 1 year. Twenty years later, a malignant left parotid carcinoma and a right jugular foramen schwannoma developed. Earlier reports in the literature suggest that radiation can induce tumors in the head and neck. The localization of both tumors and the histological features of the parotid tumor suggest that they were radiation-induced.

VERTEBRATES

REFER ALSO TO CITATION(S) 40359

40406 (LA—6717-MS) **Delayed radiation injury of gut-exposed and gut-shielded mice. I. The decrement in resistance to continuous gamma-ray stress.** Spalding, J.F.; Archuleta, R.F.; London, J.E.; Prine, J.R. (Los Alamos Scientific Lab., N.Mex. (USA)). Feb 1977. Contract W-7405-ENG-36. 10p. P 02/MF A01.

Two mouse strains (RF/J and C57B1/6J) were exposed to x-ray doses totaling 400, 800, or 1200 rad. Total doses were given in 200-rad fractions at 7-day intervals to the whole body, gut only, or gut shielded. Animals treated as above (conditioned) were divided into 2 groups to form a two-part investigation. X-ray-conditioned and control mice were subjected to a continuous gamma-ray stress (challenge exposure) 28 days after the last x-ray dose. Delayed injury was measured as a reduction in mean after-survival (MAS) time and was observed in whole-body, gut-conditioned, and gut-shielded groups. The cause of death was attributed to hemopoietic hypoplasia in all groups. MAS reduction in all conditioned groups in both strains was linear with dose within the dose range used. Delayed injury per volume dose (measured as a reduction in MAS) was independent of the tissue initially conditioned with an acute dose of x rays. Thus, delayed injury per unit weight of gut tissue exposed was equal to that of either whole-body or gut-shielded radiation injury. Comparative weight loss observations during the continuous gamma-ray challenge exposure revealed a decrement in metabolic processes associated with body weight maintenance. This decrement was seen in all x-ray-conditioned groups.

40407 (TID—26113-P2, pp 167-180) **Small mammals in a gamma-irradiated northern forest community.** Buech, R.R. (North Central Forest Experiment Station, St. Paul). 1977.

In Enterprise Forest. Volume II. Radioecological studies.

Radiation exposure was measured on individual small mammals living around a 10,000-Ci ^{137}Cs gamma-radiation source at the

Enterprise Radiation Forest located near Rhinelander, Wis. During the irradiation from May to October 1972, dosimeter returns were obtained from 67 individuals representing six different genera and seven species: Tamias striatus (30), Peromyscus maniculatus and P. leucopus (20), Tamiasciurus hudsonicus (13), Clethrionomys gapperi (2), Glaucomys volans (1), and Eutamias minimus (1). The dosimetry technique developed proved to be very satisfactory. Measurements obtained were subjected to regression techniques to estimate potential exposures from home range information. The relationships between measured and estimated potential exposure are discussed for Tamias, Peromyscus, and Tamiasciurus. A significant difference in body weight change was found between control and irradiated Tamias subadults. However, under the conditions of the experiment, body weight was generally not very sensitive to the radiation levels imposed on the site. Observations of external indicators of breeding condition and survival failed to produce evidence that either was affected by radiation.

40408 (TID—26113-P2, pp 181-184) **Observations of nesting avifauna under gamma-radiation exposure.** Buech, R.R. (North Central Forest Experiment Station, St. Paul). 1977.

In Enterprise Forest. Volume II. Radioecological studies.

An opportunity arose to observe the nesting success of birds (up to the time of fledging) when the Enterprise Forest Radiation Facility was established for a study of the effects of gamma radiation on the flora and fauna of northern forest communities. The results of these observations on the fate of the nest occupants in relation to radiation exposure are presented.

40409 (AD-A—028273) **Problems of postradial recovery.** Akoev, I.G. 1975. Translation of unidentified Russian language article, 368p, 1970. (USAMIIA-K—0424). 307p. NTIS $9.75.

The monograph is devoted to the restoration of the organism following the effects of ionizing radiation. The fundamental quantitative laws have been determined for the restorative processes for various conditions of radiation effect. Relationships have been established for the first time determining the rate of restoration of dosages and power of radiation dosages, fractioning, and repetitiveness of radiation. The evolution of radiation damage by time, detected by the method of double irradiation and other methods, is reviewed is associated with clinical and pathophysiological aspects of the problem. Factors are reviewed which define the clinical 'manifestation' of radiation aftereffects. The effects of means of chemical prophylaxis and hormonal preparations are clarified. Elements of compatibility and divergence are described in the processes of damage development and restoration in various biological types. (GRA)

40410 (AD-A—028737) **Prophylaxis and therapy of aggressions chemical protection against radiation.** Fatome, M.; Bernard, P. 13 Mar 1975. Translation of Prophylaxie et Therapeutique des Agressions Radio-protection Chimique (France), n.p., n.d., p83-88. (USAMIIA-K—5439). 16p. NTIS $3.50.

Contents: Chemical Protection Against Radiation; Study of the Radiation Protection Capability of Phenylhydrazine; Radioprotective effect of C511 injected 24 Hours before Irradiation with lethal dose; and The influence of cysteamine and a mixture of radioprotective agents on the Polynuclear bodies and Lymphocytes of irradiated mice. (GRA)

40411 (ERDA-tr—241, pp 97-101) **Protective effect of pantothenic acid (vitamin B_3) on radiation sickness.** Perepelkin, S.R.; Egorova, N.D.; Kovalenko, V.A.; Demin, V.I. (Moscow Medical Inst.). 1976. Translated from Radiobiologiya; 16: No. 5, 722-726(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

A study was made of the protective effect of pantothenic acid (vitamin B_3) ingested by mouth with food, in doses of 150, 750 and 1500 μg per animal, in experiments on white male rats exposed to whole-body radiation in a dosage of 600 R. It was found that this vitamin increases radioresistance of the organism, when given in the first two doses. In a dosage of 1500 μg, vitamin B_3 aggravates the severity of radiation sickness.

40412 (ERDA-tr—241, pp 79-84) **Effects of lymphocytes on hemopoiesis in the irradiated organism.** Shvets, V.N. 1976. Translated from Radiobiologiya; 16: No. 5, 707-711(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

A study was made of the effect of lymphocytes of lymph nodes and the thymus on differentiation of hemopoietic stem cells in mice. It was established that primarily colonies of the erythroid type were formed with interaction of medullary and thymus cells in the spleen and medullary canal of syngenic recipients. Cortisone-resistant thymus cells exercised such an effect. Lymph node cells had an analogous property. In a nonsyngenic organism (parentyieldshybrid), thymus and lymph node lymphocytes did not have the same properties. The thymus cells, like in the syngenic variant of the experiment, intensified differentiation of stem cells in the erythroid direction, regardless of the site of their proliferation (spleen, bone marrow). In the case of interaction between lymph node cells and bone marrow of the parental genotype, the effect consisted of redifferentiation of stem cells from the erythroid to the myeloid route.

40413 (ERDA-tr—241, pp 91-96) **Effect of ionole on the process of postradiation recovery of small intestine enterocytes.** Vazilo, V.E.; Parshkov, E.M.; Brodskii, R.A.; Nesterenko, V.S. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). 1976. Translated from Radiobiologiya; 16: No. 5, 717-721(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

An autoradiographic study was made of DNA synthesis in enterocytes of the mouse small intestine and migration of enterocytes in the "crypt-villus" system with γ-irradiation in a dosage of 1000 rad and under the combined effect of radiation and ionole. It was shown that ionole delays onset of the period of inhibition of DNA synthesis in proliferative crypt cells and aids in longer retention of enterocytes on the villi.

40414 (ERDA-tr—241, pp 102-107) **Evaluation of functional activity of canine testes continuously exposed to gamma radiation for six years.** Fedorova, N.L. 1976. Translated from Radiobiologiya; 16: No. 5, 727-731(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

Male dogs were exposed to chronic γ irradiation for 6 years, at the rate of 0.06, 0.17 and 0.34 rad/day (cumulative doses of 126, 380 and 750 rad). The functional changes in the testes were related more to the dose rate than cumulative dosage, and they were distinctly manifested in animals exposed to a dosage of 0.34 rad/day with accumulation of 80-100 rad. During the experiment, there was lower function of spermatogenic epithelium of these male dogs.

40415 (ERDA-tr—241, pp 113-117) **Effect of age on long-term sequelae of external beta irradiation in rats.** Moskalev, Yu.I.; Shelesnova, V.I. 1976. Translated from Radiobiologiya; 16: No. 5, 736-739(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

Total-body irradiation of 4- to 6-month and 1-month female rats in doses of 200 to 1600 rad of ^{90}Sr—^{90}Y β-rays had little effect on mean life expectancy. There was a higher incidence of benign and malignant mammary gland tumors, and development of skin and bone tissue tumors in irradiated animals. Young rats are more sensitive to induction of mammary tumors than adults. With exposure to a dosage of 1600 rad, young rats developed sarcoma of the skin more often, and adults more often developed basal- and squamous-cell carcinoma. Bone tissue tumors were demonstrated only in adult rats exposed to doses of 800 to 1600 rad.

40416 (ERDA-tr—241, pp 122-130) **Combined effect of acceleration and two-fold exposure to radiation in doses of 50 and 100 R on conditioned reflexes of rats and on transfer of maze experience.** Meizerov, E.S. 1976. Translated from Radiobiologiya; 16: No. 5, 744-749(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

Conditioned reflexes are the most sensitive to two-fold irradiation in a total dosage of 150 R, lateral accelerations (10 g, 4 min) and the combined effect of these factors. The capacity to transfer maze experience is somewhat less sensitive, and a developed maze skill is considerably more resistant. The combined effect of radiation followed by acceleration was more marked than exposure to the same factors in reverse order.

40417 (ERDA-tr—241, pp 138-141) **Effects of ionizing radiation on ion transport processes in hepatic mitochondria.** Medvedev, B.I.; Evtodienko, Yu.V.; Kuzin, A.M. (Inst. of Biological Physics, Pushchino, USSR). 1976. Translated from Radiobiologiya; 16: No. 5, 756-759(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

According to structural metabolic theory, an important stage in radiation lesion to the cell is impairment of processes of energy conversion in the mitochondria. A considerable part of the published works dealing with the effects of radiation on mitochondrial function describes changes in rate of respiration and phosphorylation, and the P/O coefficient. However, the mechanism of the changes observed is still not entirely clear. According to current conceptions, the processes of energy conversion in mitochondria (including ATP synthesis) are based on reactions of membrane potential generation and electrogenic transport of H^+ ions. For this reason, it is interesting to demonstrate possible changes in permeability of mitochondrial membranes and ion transport in mitochondria under the influence of ionizing radiation. In the present work, we investigated the effects of ionizing radiation on oxidative phosphorylation, magnitude of membrane potential and ion transport in mitochondria of the rat liver. The results obtained show that, at the early postradiation stages, one can demonstrate distinct changes in the system of energy conversion in hepatic mitochondria, in particular in the ion transport system. The observed increase in rate of ATP synthesis 3 hours after irradiation may be interpreted as a compensatory process related to an increased energy demand. The postradiation increase in "calcium capacity" and decrease in permeability of potassium ions in mitochondria are perhaps the consequence of radiation damage to the system of energy transformation in cells.

40418 (ERDA-tr—241, pp 142-144) **Effects of exposure to divided doses of x-rays, as well as chronic radiation and chronic radiation**

combined with acute cobalt-60 gamma radiation, on catecholamine content of rat myocardium. Karpovich, N.V. (Inst. of Physiology, Minsk). 1976. Translated from Radiobiologiya; 16: No. 5, 759-761(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

The significance of catecholamines as regulators of adaptational reactions of the heart is determined, first of all, by their capacity to activate metabolic processes in the myocardium and intensify access of nutrient and energy substrates from other organs and tissues. At the present time it can be considered proven that the concentration of catecholamines in the myocardium is related to capture of biogenous amines from circulating blood, synthesis and secretion thereof from sympathetic nerve endings and extraneuronal deposition. Most of the monoamines demonstrated in the mammalian heart consist of norepinephrine, while the concentration of dopamine is much lower. Analysis of the literature of recent years warrants the statement that the myocardium is relatively resistant to diverse stressors. However, there is extremely limited information concerning the effects of ionizing radiation on catecholamine content of the myocardium. At the same time, it is known that radiobiochemical changes are observed in the myocardium under the influence of acute and chronic ^{60}Co γ radiation, as well as x radiation. For this reason, it was interesting to investigate the concentration of norepinephrine and dopamine in the myocardium of white rats during and after exposure to ionizing radiation in small doses. Analysis of the obtained results indicates that the changes demonstrated in each series of experiments are far from identical, either in intensity or direction, and they are related not only to cumulative dosage, but largely to the nature of the radiation factor. The changes established in catecholamine content of the myocardium under the above experimental conditions should be taken into consideration when assessing the radiobiochemical changes that occur in the organism at different postradiation times.

40419 (ERDA-tr—241, pp 151-155) **Effect of heterologous high polymer DNA on restoration of colony-forming units in hemopoietic tissues of irradiated mice.** Luzanov, V.M. 1976. Translated from Radiobiologiya; 16: No. 5, 767-770(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

It is imperative to investigate the effects of DNA preparations on colony-forming units (CFU) in order to comprehend processes of recovery of hemopoiesis in irradiated and DNA-treated animals. The data in the literature dealing with this question are sparse and contradictory. In this work, we studied the effect of heterologous DNA obtained from the calf thymus and fish milt on restoration of CFU in bone marrow and spleen of irradiated mice. Restoration of CFU should be directed, first of all, toward normalization of cellular composition of bone marrow and spleen. The number of myelokaryocytes in bone marrow was higher between the 6th and 20th days in treated mice than in untreated animals. Probably this was due to increased differentiation of CFU. Thus, administration of heterologous DNA to irradiated mice accelerated recovery of CFU in bone marrow and spleen, due to the effect of this biopolymer on processes of proliferation and migration of colony-forming units.

40420 (ERDA-tr—241, pp 156-159) **Erythropoietic activity of plasma of irradiated animals.** Gritsak, A.N.; Starodub, N.F.; Rekun, G.M.; Shur'yan, I.M. (Inst. of Molecular Biology and Genetics, Kiev). 1976. Translated from Radiobiologiya; 16: No. 5, 770-773(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

In the recent literature, there is discussion of the role of erythropoiesis-stimulating factors, the presence of which has been demonstrated in human and animal blood. There is a sharp increase in erythropoietin production following bloodletting, in the presence of hypoxia and diverse types of anemia. Yet, there are only isolated works dealing with erythropoietic activity of plasma of animals with postradiation anemia, and their findings are quite contradictory. In this work, we submit experimental data on the effects of ionizing radiation on erythropoietic activity of rat plasma, in vivo and in vitro, which is a mandatory stage in learning about the mechanism of postradiation injury to the hemopoietic system, bearing in mind the role of erythropoietic factors in maintaining the quantitative parameters of erythron. The combination of x-rays and phenylhydrazine elicits a somewhat lesser effect than each factor separately. Thus, in the course of radiation sickness in rats, a decline in erythropoietic activity of plasma was observed on the 1st day after 3-fold injections to irradiated animals. In the dosage we used, phenylhydrazine probably has a radioprotective effect. In this regard, of interest are data to the effect that phenylhydrazine, in small doses (10 mg/kg), has a radioprotective effect and stimulates cell division in hemopoietic tissue regardless of time of administration, whereas in a dosage of 100 mg/kg it increases radiosensitivity and inhibits erythropoiesis. Yet, there is a report that there was a high level of erythropoietin in the plasma of mice exposed successively to 100 R x rays and phenylhydrazine (up to 80 mg/kg). Thus, in the course of radiation sickness in rats, as in the case of phenylhydrazine anemia, a reliable increase is observed in erythropoietic activity of plasma.

40421 (ERDA-tr—241, pp 160-163) **Role of tocopherol (vitamin E) in the concomitant deleterious effect of postradiation hyperoxia.** Ivanov, I.F. (Kiev Scientific-Research Inst. of Roentgenoradiology and Oncology). 1976. Translated from Radiobiologiya; 16: No. 5, 773-776(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

One of the best known natural antioxidants that is consistently present in the organism is vitamin E (tocopherol). It is not synthesized de novo in animal tissues, so that the organism's vitamin E requirements are met by means of exogenous sources. Tocopherol is ingested in a biologically inactive form and then undergoes several enzymatic conversions. Under experimental conditions, following intraperitoneal injection of tocopherol, a maximum increase in hepatic lipids, in biologically active (free) form occurred by the 18th hour. After administration per os tocopherol is stored in various organs, particularly in the liver where a maximum is demonstrable in 6 hours. It is assumed that conversion of tocopherol into active form is relatively easier in this instance, as compared to intraperitoneal administration, due to processing thereof by secretions of gastrointestinal glands. On the basis of the foregoing, our objective was to make a quantitative evaluation of the effect of tocopherol on postradiation hyperoxia when given both before and after irradiation. The obtained data demonstrated unequivocally that, in the integral organism of warm-blood animals, the additional deleterious effect of postradiation hyperoxia can be averted by means of preliminary (6 to 18 hours before irradiation) administration of tocopherol. The existence of a latency period in tocopherol action is, apparently, due to the need for it to change into a biologically active form. The duration of this period coincides with the time of conversion into free form with antioxidant properties. For this reason, we cannot rule out the possibility that the additional deleterious effect of postradiation hyperoxia is due to activation by oxygen of free oxidation in irradiated tissues and, in particular, peroxidation, in the reactions of which tocopherol is a specific blocking factor.

40422 (ERDA-tr—241, pp 164-167) **Dynamics of myelokaryocytes during prolonged and repeated gamma irradiation.** Voronin, V.S.; Murzina, L.D.; Sukhodoev, V.V. 1976. Translated from Radiobiologiya; 16: No. 5, 777-779(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

Changes in number of myelokaryocytes with irradiation of small laboratory animals are evaluated by counting medullary cells in the femur. However, in the case of protracted irradiation, when irradiated animals gain weight at an appreciably slower rate than intact ones, the use of this method may distort the true results. Hence, the objective of the present work was to make a dynamic study of myelokaryocytes in the entire skeleton in the course of prolonged irradiation of rats, and to compare these data to the change in number of cells in the femur. There was a difference in dynamics of bone marrow cell content of the rat skeleton with the two different daily doses of radiation. While no changes in number of myelokaryocytes, as compared to intact animals, were noted with exposure to 25 R/day for 8 months, with a daily dose of 50 R their number declined from the very start of the experiment. These differences are, apparently, due to less destruction of medullary cells with the low daily dosage and more profound injury to compensatory mechanisms with 50 R/day. Other investigators have also reported differences in change in number of myelokaryocytes with different daily doses of radiation. It is important to mention that, with both doses used, the dynamics of quantitative composition of femoral bone marrow cells, with consideration of the correction factor, reflected quite accurately the nature of change in number of karyocytes in the entire skeleton of the animal.

40423 (ERDA-tr—241, pp 168-171) **Hemopoiesis in dogs exposed to repeated nonuniform gamma radiation.** Kalandarova, M.P. 1976. Translated from Radiobiologiya; 16: No. 5, 779-782(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

In this work, we studied changes in canine bone marrow as related to different variants of repeated irradiation. The dogs were exposed to radiation four times, to a cumulative "input" dosage of 1300 rad (dose rate on the surface of the animal, 120 rad/hour, dorso-ventral gradient in depth, 2.8). The most significant changes in medullary hemopoiesis were observed in dogs exposed to radiation twice during the period of depressed hemopoiesis (7th day after the first exposure): throughout the observation period, erythroblast element content constituted 130 to 205% of the base level, and myeloblast elements, 47 to 74%. In the cases of repeated irradiation at 60-day intervals, myeloblast and erythroblast precursor cells constituted 85 to 90% and 80 to 140% of the base values, respectively, throughout the observation period. The lowest leukocyte level (22% of normal) was inherent in dogs exposed to radiation twice at a 6-day interval. When the interval was 60 days, the minimum leukocyte count was 65% of the base level. We observed faster restoration of granulocytopoiesis in dogs irradiated twice at a 2-month interval: leukocyte count reached normal levels by the 35th day. In contrast, dogs irradiated twice at a 6-day interval presented a leukocyte count that did not exceed 80% of the background data, even on the 45th day of observation.

40424 (ERDA-tr—241, pp 172-175) **Mechanism of therapeutic action of different doses of DNA in rats with radiation lesion.** Rogacheva, S.A.; Turdakova, V.A. 1976. Translated from Radiobiologiya; 16: No. 5, 783-785(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

The therapeutically most effective doses of DNA in the presence of acute radiation lesion constituted 3 to 5 mg per rat. In a dosage of 1 mg, while DNA restores the number of myelokaryocytes, it does not increase animal survival. For this reason, a study was made of the effects of the above doses of DNA on bone marrow composition in irradiated rats. Male Wistar rats, weighing 170 to 180 g, were exposed to ^{137}Cs γ radiation in a dosage of 810 R, at the rate of 26.9 R/min (LD/sub $^{70}/_{30}$/). Homologous splenic DNA, (molecular weight, 28 million dalton, RNA content—2 percent, protein—0.5 percent), was injected subcutaneously 1 day later in doses of 1, 3 and 5 mg. We determined the number of myelokaryocytes in the femur, myelogram and mitotic activity of granulocytes and erythronormoblasts at different postradiation times in 3 or 4 rats from each group. At all examination periods, we observed a correlation between mitotic activity of myelokaryocytes and administered dosage of DNA. The absolute number of mitoses in rats given DNA in doses of 3 and 5 mg was considerably higher on the 3rd day than in the control (P less than 0.05). By the 3rd postradiation day, the number of cells in bone marrow of untreated rats dropped from 167 to 6.6 million. In DNA-treated animals there were 1.5 times more cells at this time (9.7 million, P less than 0.05). By the 10th day, there were 3 times more myelokaryocytes in rats given 3 mg DNA than in the control (28.9 million versus 9.6 million, P less than 0.05). The differences were attributable both to proliferative and, particularly, maturing cells.

40425 (ERDA-tr—241, pp 176-178) **Early reactions of mouse integument to single exposure to accelerated boron ions.** Savchenko, N.Ya. 1976. Translated from Radiobiologiya; 16: No. 5, 786-788(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

There is a probability of skin lesion in virtually all cases of external exposure to radiation. There is a vast literature dealing with irradiation of the skin, in which a rather comprehensive study has been made of the radiation reaction of human and animal skin to specific dose levels. However, there is not enough information concerning the quantitative dose-effect relationship for various forms of skin reactions. There are extremely few data on the condition of the integument when the LET (linear energy transfer) values are high. Our objective was to establish the dose-effect function for early reactions of mouse skin to accelerated boron ions. It was established that an acute skin reaction develops with exposure to boron ions with all dose levels used, and it can be defined as erythema, dry and exudative epidermitis ulceration and atrophy. With doses of 500 and 600 rad, there was development of mild and moderate erythema; with 700 and 800 rad, dry epidermitis. Exposure to boron ions in doses of 1500 to 1800 rad led to development of exudative epidermitis on the 8th to 10th day with ulcerations in 85 to 90 percent of the cases with doses of 1700 to 1800 rad. The ulcerations appeared on the 10th to 15th day. Restoration of fur was observed following radiation in doses not exceeding 1500 rad. With larger doses, epithelization occurred to the end of the observation period; however, restoration of their coats was not observed even by the 90th postradiation day. The results illustrated in the figure enable us to derive a quantitative expression of severity of skin reaction as function of radiation dose. It is known that the biological effects of exposure of the skin to radiation fluctuate significantly, depending on thickness and elasticity of the skin, intensity of blood supply to a particular part of the body, depth of accretion of maximum radiation dosage, animal species, etc.

40426 (ERDA-tr—241, pp 179-183) **Testicular reaction to combined radiation.** Kondratenko, V.G.; Ganzenko, L.F. (Inst. of Biological Physics, Pushchino, USSR). 1976. Translated from Radiobiologiya; 16: No. 5, 788-791(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

In view of the broad development of atomic energy and possible use of space stations, it is interesting to investigate the effects of chronic radiation in low doses combined with a single dose of irradiation. In this work, we investigated the testicular reaction of animals exposed to combined radiation. The testicular reaction to combined radiation resembles the one seen with delivery of divided doses of radiation to these organs. However, it should be stressed, that this is only an external similarity, since there are more profound disturbances in the seminiferous tubules with combined radiation, they are manifested with lower doses and when the intervals between exposures are considerably longer. All this is indicative of the specific reaction of the testes to combined radiation. In our opinion, the described changes in the spermatogenic epithelium induced by ionizing radiation cannot be interpreted as being merely the result of local disturbances. They are apparently determined by impairment of complex neurohormonal mechanisms of regulation of spermatogenesis.

40427 (ERDA-tr—241, pp 184-187) **Effects of benzene on the irradiated organism. Mechanism of its radiomimetic action.** Karaulov, A.V.; Yushkov, B.G.; Frash, V.N. (Scientific-Research Inst. of Industrial Hygiene and Occupational Diseases, Sverdlovsk, USSR). 1976. Translated from Radiobiologiya; 16: No. 5, 791-794(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

The radiomimetic effect of benzene has been described, but the mechanism thereof is not clear. In this work, we investigated the effect of benzene on the irradiated organism, using a model of adaptive immunity that had not been previously used for this purpose. Thus, administration of benzene to immunized mice altered the structure of the lymphoid population of the spleen, with reduction of T and B cell content, whereas lymphopenia of peripheral blood was primarily of a T-cell nature. Probably, these changes are manifested by the lower immune response under the influence of benzene in normal mice, and delayed restoration of immunogenesis (RFC formation) in the case of adaptive transfer in irradiated animals. Another distinction of the effect of benzene on the irradiated organism is the decreased effectiveness of colony formation, which we demonstrated in mice given benzene following transplantation of normal bone marrow. It may be assumed that these two aspects of the radiomimetic action of benzene (depression of immunogenesis and decreased effectiveness of colony formation) are closely interrelated. Indeed, the importance of cooperation between T-lymphocytes and hemopoietic stem cells in the mechanism of postradiation regeneration of hemopoiesis has been demonstrated in several works. The changes in the lymphoid population and immunogenesis demonstrated under the influence of benzene may therefore have the significance of a triggering mechanism in development of benzene impairment of hemopoiesis in normal animals, and in irradiated ones it may aggravate the radiation lesion. The possibility of change in cellular interactions that regulate hemopoiesis under the influence of benzene is also confirmed by the change in cytological distribution of colonies in irradiated animals after administration of benzene.

40428 (ERDA-tr—241) **Radiobiology, Vol. 16, No. 5, 1976.** Translation of *Radiobiologiya;* **16**: No. 5, 643-800(1976). 198p. Dep. NTIS $7.50.

Separate abstracts were prepared for the 34 papers presented in this issue. (ERB)

40429 (ERDA-tr—241, pp 18-28) **Effects of ionizing radiation on enzymes of carbohydrate metabolism.** Cherkasova, L.S.; Mironova, T.M. (Inst. of Physiology, Minsk). 1976. Translated from Radiobiologiya; 16: No. 5, 657-664(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

On the basis of the data in the literature and the results of studies conducted in our laboratory, it is concluded that ionizing radiations do not elicit severe changes in activity of enzymes of carbohydrate metabolism in the tissues of the animal organism. Data are submitted on the effects of whole-body single, divided dose or chronic irradiation on enzymes of carbohydrate metabolism and the interrelated cooperative redistributions that occur in processes of aerobic and anaerobic glycolysis and pentose route of conversion thereof. It was shown that there is a correlation between the postradiation changes in enzyme activity and reaction to irradiation of the neuroendocrine system.

40430 (ERDA-tr—241, pp 29-35) **Effects of ionizing radiation on superoxide dismutase activity as demonstrated by the chemiluminescence method.** Lipin'ski, S.; Lipetska, K.; Donets, Ya.; Kan'ski, M. (Physiological and Biological Inst., Lodz, Poland). 1976. Translated from Radiobiologiya; 16: No. 5, 665-670(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

A study was made of activity of superoxide dismutase (SOD) isolated from the rabbit liver, using a specially developed method of chemiluminescent inhibition of luminol in a ferrocyanide-luminol system. Studies were made of changes in SOD activity in rabbit liver tissue after exposure to 1000 R radiation. It was demonstrated that there is a 35 percent decrease in SOD activity 24 hours after irradiation. SOD activity reverts to the normal level 72 hours after irradiation.

40431 (ERDA-tr—241, pp 36-43) **Effect of x-rays on isolated nuclear membranes.** Tongur, A.M.; Volkova, M.S.; Pavlovskaya, T.E. (Inst. of Biochemistry, Moscow). 1976. Translated from Radiobiologiya; 16: No. 5, 671-677(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

It was established that the nuclear membranes of the calf thymus, isolated with and without the use of DNAase, form oriented layers with high elastic properties on the air—water phase interface. X irradiation of a suspension of nuclear membranes, in a dosage of 100 kR, elicits slower formation of the oriented layers and increases their elasticity. The layers of nuclear membranes have specific properties, depending on how they are stacked on the interface: when packed more densely they serve as a barrier, and in maximum extended state they are capable of activating the enzymatic process. Exposure to 100 kR radiation results in structural changes in membranes, reduction of barrier function and increase in catalytic proper-

ties of membranes, apparently related to production of lipid peroxides. Irradiation of nuclear membranes isolated with the use of DNAase elicits more profound changes, as indicated by impairment of surface properties, function and morphology of membranes.

40432 (ERDA-tr—241, pp 50-54) **Investigation of mechanisms of taurine hyperexcretion following whole-body irradiation.** Bezkrovnaya, L.A.; Lapteva, T.A.; Dokshina, G.A.; Baranova, M.I. (Tomsk State Univ., USSR). 1976. Translated from Radiobiologiya; 16: No. 5, 683-686(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

A study was made of the mechanism of post-radiation hyperexcretion of taurine in urine. There was increased excretion of taurine for 3 days after total-body irradiation of rats in a dosage of 700 rad. It was established in in vitro experiments that there is diminished taurine synthesis in the thymus and liver of irradiated animals. Concurrently, reduction of the thymus and decreased taurine content in this organ were observed. It was shown that postradiation hyperexcretion of taurine is partially due to release thereof from lymphoid tissue (thymus).

40433 (ERDA-tr—241, pp 62-67) **Changes in number and proliferative activity of hemopoietic stem cells during prolonged external gamma-irradiation.** Muksinova, K.N. 1976. Translated from Radiobiologiya; 16: No. 5, 693-698(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

Prolonged daily exposure of BALB/c mice to 25 and 50 R/day radiation (at the rate of 10 R/min) led to appreciable depletion of CFC [colony-forming cells] population in the bone marrow and spleen. The rate and severity of CFC decline were more marked in the group of animals exposed to 50 R/day. A significant increase in proliferative pool of CFC maintained the population of these cellular elements throughout a long period of irradiation. The authors discuss the possible mechanisms of the demonstrated changes in number of CFC and their functional state.

40434 (ERDA-tr—241, pp 68-72) **Changes in kinetics of erythronormoblast proliferation during prolonged gamma irradiation.** Voronin, V.S.; Murzina, L.D. 1976. Translated from Radiobiologiya; 16: No. 5, 699-702(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

No decrease in number of erythronormoblasts was demonstrable after exposing Wistar rats to 48.5 rad/day radiation for 70 days. Compensation of erythropoiesis may be related to faster proliferation of erythropoietic elements of bone marrow. This process is due to 25—30 percent reduction of erythronormoblast generation time and increased number of divisions of erythroblasts and basophil normoblasts.

40435 (PB—257937) **CSU-FDA Collaborative Radiological Health Laboratory annual report, 1975.** Shore, M.L. (Colorado State Univ., Fort Collins (USA). Coll. of Veterinary Medicine and Biomedical Sciences). Jul 1976. Contracts FDA-72-302;FDA-223-76-6002. 156p. NTIS $6.75.

See also annual report dated 1974, PB—246722.

The Collaborative Radiological Health Laboratory was conceived in 1962 as a joint operation between the Division of Biological Effects and the Department of Radiology and Radiation Biology, Colorado State University, to conduct a study of the long-term effects in the beagle from low-level, wholebody gamma irradiation. The first section summarizes current investigations in the developing animal. The second section describes pathologic and hemodynamic findings in the prepubertal adult and aging animal, including development of ultrasound devices for measurement of organ function, providing the foundation for major experimental work. The third section analyzes some colony statistics, study design, and dosimetry. (GRA)

40436 **Effects of grafts of single anterior pituitary glands on the incidence and type of mammary neoplasm in neutron- or γ-irradiated Fischer female rats.** Clifton, K.H.; Douple, E.B.; Sridharan, B.N. (Univ. of Wisconsin, Madison). *Cancer Res.;* **36**: No. 10, 3732-3735(Oct 1976).

Three batches comprised of 48 young adult Fischer female rats each were subjected to total-body irradiation with 50 rads modified fission neutrons, or were given 600 rads ^{137}Cs γ-rays, or served as unirradiated controls. On the day following exposure, one-half of each batch was grafted with a single anterior pituitary gland beneath the left kidney capsule. The animals were observed for mammary neoplasia and all those that died during the experiment were autopsied. The experiment was terminated 538 +- 13 days after irradiation when all neutron-irradiated, pituitary-grafted animals had one or more mammary tumors. Only 2 of the 23 untreated rats that survived until termination of the experiment developed mammary fibroadenomas, and none had mammary carcinomas. The incidence of fibroadenomas was increased, and a single carcinoma was found in unirradiated rats with pituitary grafts. Irradiation alone caused an increase in the incidence of mammary fibroadenomas and the appearance of carcinomas. Fibroadenomas were markedly increased by the addition of pituitary grafts to irradiation. Carcinoma incidence was less markedly affected. The neutron dose of 50 rads was slightly more effective in inducing mammary neoplasms than the 600-rad dose of γ-rays.

INVERTEBRATES

40437 **Sexual competitiveness of adult Indian meal moths irradiated as mature pupae.** Ahmed, M.Y.Y.; Brower, J.H.; Tilton, E.W. (Agricultural Research Service, Savannah). *J. Econ. Entomol.;* **69**: No. 6, 719-721(15 Dec 1976).

When 7-day-old pupae of Plodia interpunctella (Huebner) were treated with 50 krad γ irradiation, 94.5 percent of the resulting females mated with untreated males, but the few eggs laid were infertile. Also, resulting males were sterile when they were paired with untreated females. A ratio of 1:1:1 irradiated males, untreated males, and untreated females resulted in 28.5 percent infertile eggs. Ratios of irradiated to untreated males of 5:1, 15:1 or 25:1 produced 54.7, 61.6, and 91.8 percent infertile eggs, respectively. Thus, irradiated males were fully competitive only at a ratio of 25:1. When both irradiated males and females were placed with untreated males and females to give ratios of 1:1:1:1, 5:5:1:1, 10:10:1:1 or 15:15:1:1, the percentages of infertile eggs were 54.1, 95.7, 81.0, and 100 percent, respectively, and competitiveness was good at all but the lowest ratio. Irradiation of 7-day-old pupae of the Indian meal moth produced sexually competitive sterile adults when released at high flooding ratios, and results were better when both sexes were released together.

BASIC STUDIES

40438 (ERDA-tr—241, pp 108-112) **Effects of exposure to single and divided doses of radiation on survival of offspring of irradiated and nonirradiated drosophila males.** Gol'zberg, K.L.; Vorobtsova, I.E. (Central Scientific Research Inst. of Roentgenology and Radiology, Leningrad). 1976. Translated from Radiobiologiya; 16: No. 5, 732-735(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

The method of delivery of divided doses of radiation was used to investigate the capacity of offspring of irradiated (F_1I) and nonirradiated (F_1C) male drosophila to correct radiation lesions leading to shorter life expectancy. The defectiveness of offspring of irradiated male specimens, with regard to this criterion, can apparently be attributed to their older physiological age.

PEST CONTROL

REFER ALSO TO CITATION(S) 40437

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

REFER ALSO TO CITATION(S) 40704

MAN

REFER ALSO TO CITATION(S) 40194, 40196, 40197, 40390, 40492

40439 **Adult height and weight of female radium dial painters, with analysis of radiation effect on growth.** Polednak, A.P. (Argonne National Lab., IL). *Hum. Biol.;* **49**: No. 1, 1-10(Feb 1977).

The relationship between exposure to internal radiation and adult height and weight was considered in a group of 556 females who worked as radium dial painters. These persons were first exposed at age 14—29 years, and height and weight were measured at age 46—80. Univariate and multivariate (multiple regression) analysis disclosed no significant overall effect of age at first exposure, or average skeletal dose, on height and weight. Possible effects of radiation on growth were assessed. For persons in the earliest birth cohort (1900—09) who were 14—17 and 18—21 years old at first exposure, skeletal dose in rads received from first exposure to age 21 was estimated and height and weight compared by dose group (0—9, 10—99 and 100 + rads). There was no evidence for an effect of dose, or age-at-first-exposure, on adult height, in agreement with findings on Japanese atomic bomb survivors exposed to external radiation at age 12—17 years.

ANIMALS

REFER ALSO TO CITATION(S) 40197

40440 (ERDA-tr—241, pp 118-121) **Hemodynamics of dogs following inhalation of polymeric plutonium-239.** Kalmykova, Z.I. 1976. Translated from Radiobiologiya; 16: No. 5, 740-743(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

Changes were observed in arterial and venous pressure, slower blood flow, increased mass of circulating blood and an

increase in amount of extracellular fluid in mongrel dogs following inhalation of polymeric plutonium-239 in doses that induce acute, subacute and chronic lesions. The time of appearance, severity and direction of the above changes are related to the magnitude of accretion of plutonium-239 in the organism and postinhalation time.

40441 (ERDA-tr—241, pp 131-137) **Estimation of distribution of absorbed energy in microstructures of tissues and organs after internal irradiation with heavy charged particles.** Stepanenko, V.F.; Zaichik, V.E. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). 1976. Translated from Radiobiologiya; 16: No. 5, 750-755(1976).

In Radiobiology, Vol. 16, No. 5, 1976.

Formulas were obtained to calculate the magnitude of absorbed energy in microstructures, taking into consideration two-way exchange of particles emitted by the structure in question and other structures, including their environment. Estimates were made for heavy charged particles, with arbitrary values for particle range, size and number of microstructures, distances between them and concentrations of emitter contained in them. The change in particle energy along the track was approximated to a function that is the same for various heavy charged particles, with arbitrary parameter values.

PLANTS

REFER ALSO TO CITATION(S) 40196, 40197

NUCLIDE KINETICS AND TOXICOLOGY

MAN

REFER ALSO TO CITATION(S) 39348

ANIMALS

40442 Distribution of various water soluble radioactive metalloporphyrins in tumor bearing mice. Hambright, P. (Howard Univ., Washington, DC); Fawwaz, R.; Valk, P.; McRae, J.; Bearden, A.J. *Bioinorg. Chem.;* 5: 87-92(1975).

The distribution of a variety of water soluble ^{109}Pd and ^{64}Cu porphyrins were studied in mice bearing three types of tumors. While the metalloporphyrins are found to have an affinity for neoplastic tissue, substantial extra-tumor concentrations are also noted. Although this limits their value as specific tumor imaging agents, their use in localized therapy is discussed.

40443 Comparison of platelet size, platelet count, and platelet ^{35}S incorporation as assays for thrombopoietin. McDonald, T.P. (Univ. of Tennessee, Knoxville). *Br. J. Haematol.;* 34: 257-267(1976).

Average platelet size, platelet count, and ^{35}S-incorporation into platelets were compared as methods for the measurement of thrombopoietin-stimulated thrombopoiesis. In mice injected with rabbit anti-mouse platelet serum (RAMPS) average platelet size was shown to be increased as mice were recovering from thrombocytopenia. Also, ^{35}S-measurements on platelets of these mice showed significant increases in cpm/average platelet 2 to 4 days after RAMPS treatment. Significant increases in ^{35}S-incorporation into the total circulating mass of platelets were found on days 3—4. In normal mice or mice in rebound-thrombocytosis injected with thrombopoietin, platelet size remained unchanged, whereas the platelet count and ^{35}S-incorporation into platelets were shown to be significantly increased. Moreover, a dose-response experiment in mice pretreated with RAMPS showed a slight increase in platelet count as the dose of TSF was increased, but platelet sizes were unaltered. The percentage ^{35}S-incorporation into platelets showed a significant linear dose-response, i.e., as the dose of thrombopoietin was increased, an increase in percent ^{35}S-incorporation into platelets was observed. These data indicated that of the three indirect measurements of thrombopoietin, the percent ^{35}S-incorporation into mouse platelets was the most sensitive, followed by platelet counting; the least sensitive measurement of thrombopoiesis was change in platelet size.

40444 (PB—256698) **Distribution of ingested americium in chickens and transport to eggs. Final report, 1975.** Mullen, A.A.; Lloyd, S.R.; Mosley, R.E. (Environmental Protection Agency, Las Vegas, Nev. (USA). Environmental Monitoring and Support Lab.). May 1976. 15p. (EPA—600/3-76/058). NTIS $3.50.

The soluble citrate complex of americium-241 was orally administered to 20 white Leghorn laying hens daily for two weeks. The yolks, whites, and shells from the eggs were analyzed for their americium content. Yolk was the only egg fraction in which radioactivity was observed. The americium-241 activity in yolks reached a maximum on the 14th day of dosing. Biological half-times of 2.00 plus or minus 0.18 days and greater than 33 days were indicated by the average concentration values of americium-241 in yolks laid after the maximum activity was reached. The hens were serially sacrificed at 1, 10, and 20 days after the final administration of americium-241. Tissue samples were collected and the americium content determined in the edible portions and feathers of the hens. Americium was detected in most tissues shortly after dosing; the main concentrations were found in the liver and the skeleton. The highest concentration per organ (3.03 X 0.001 percent of the dose) occurred in the liver of the hens sacrificed 10 days after final administration of americium-241. (GRA)

40445 Effects of manganese on carcinogenicity and metabolism of nickel subsulfide. Sunderman, F.W. Jr.; Kasprzak, K.S.; Lau, T.J.; Minghetti, P.P.; Maenza, R.M.; Becker, N.; Onkelinx, C.; Goldblatt, P.J. (Univ. of Connecticut, Farmington). *Cancer Res.;* 36: 1790-1800(May 1976).

Nickel subsulfide, Ni_3S_2, alone or combined with manganese or chromium dusts, was administered i.m. to Fischer rats to study the effects of the metals upon Ni_3S_2 induction of sarcomas at the injection site. The incidence of sarcomas within 2 years after injection of Ni_3S_2 (1.2 mg) plus manganese (1.0 mg) was 7%, versus 77% in rats that received only Ni_3S_2 (1.2 mg), and 80% in rats that received Ni_3S_2 (1.2 mg) plus chromium (1.0 mg) (rho less than 0.005). No local sarcomas occurred in rats that received the injection vehicle, or in rats that received manganese or chromium without Ni_3S_2. Admixture of manganese diminished the solubility of $^{63}Ni_3S_2$ in rat serum, serum ultrafiltrate, or water, in vitro. Admixture of manganese with $^{63}Ni_3S_2$ does not affect the mobilization or excretion of ^{63}Ni in vivo, nor did it alter the acute pathological reactions to Ni_3S_2. ^{63}Ni concentrations in ultrafiltrates of supernatant fractions of homogenates of injection sites averaged 2.8 (S. D. +-0.7) ng/ml at 5 to 6 months after injection of $^{63}Ni_3S_2$ (1.2 mg) plus manganese (1.0 mg), versus 5.4 +- 2.0 ng/ml after injection of only $^{63}Ni_3S_2$ (1.2 mg) (rho less than 0.02). This study demonstrates that admixture of manganese dust and Ni_3S_2 inhibits Ni_3S_2 tumorigenesis in rats, and reveals that manganese dust affects the subcellular distribution of ^{63}Ni derived from $^{63}Ni_3S_2$, without influencing ^{63}Ni kinetics as estimated by compartmental analysis.

MICROORGANISMS

40446 Microcosm experiments on element transfer. Witkamp, M. (Oak Ridge National Lab., TN). *Int. J. Environ. Stud.;* 10: 59-63(1976).

Transfer of elements in microcosms is illustrated using results from multifactorial experiments with microcosms of increasing complexity. Major factors affecting element transfer from detritus to roots are rate of leaching and the nature of the leachate, microbial immobilization, and release of elements, and the primarily mechanical action of fauna on detritus and microflora. Effect of mineral soil on mineral transfer under the conditions of the experiments were only minor. Use of radionuclides in the experiments and of systems analysis of the data provides coefficients of gross transfer and predictions of transfers under conditions other than those of the experiments.

THERMAL EFFECTS

40447 Functional analysis of a thermal spring ecosystem, with an evluation of the role of consumers. Collins, N.C. (Univ. of Toronto, Mississauga); Mitchell, R.; Wiegert, R.G. *Ecology;* 57: No. 6, 1221-1232(Aut 1976).

Low temperature (less than 40°C) alkaline thermal spring effluents in Yellowstone National Park support a benthic algal-bacterial met fed upon by a single herbivorous brine fly (Diptera: Ephydridae), which in turn is consumed by a number of arthropod predators (water mites, spiders, and a predaceous fly). Growth of the algal-bacterial mat appears to be nutrient limited; measures of free CO_2 concentrations are good predictors of the differences in productivity within and among springs. Paracoenia turbida, the herbivore, saturates all suitable oviposition sites, and its larvae destroy all algae available below them. The larvae suffer substantial density-dependent mortality late in their development, when they consume algal dams protecting them from hot water flows. Algal-bacterial biomass persists because, at any one time, most of the mat is too hot for larvae, or is covered by flowing water and consequently unsuitable for oviposition. The brine fly eggs which constitute the prey for most predators are also largely unavailable because the flies insert them into the algal-bacterial mat, where they are difficult to remove and feed upon. The demand-availability ratio for fly eggs is high; therefore reproduction of the major predatory water mite, Partnuniella thermalis (Hydrachnellae) is probably limited by the supply of available eggs. Both primary and secondary consumers seem to be resource limited because most of their prey are unavailable. The important role of refuges in defining the biomass structure of this ecosystem prompted a definition of four conditions which tend to limit consumer influence on prey density: (1) evolutionary specialization by consumers, which narrows the spectrum of potential food; (2) poor food quality which does not allow population growth; (3)

evolved defenses of the prey; (4) the degree of uncertainty in resource distribution in space or time.

MICROORGANISMS

40448 (PB—257673) **Cooling water discharge research project. Progress report.** Brush, L.M. Jr.; Jensen, L.D.; Wolman, M.G. (Ecological Analysts, Inc., Baltimore, Md. (USA); Johns Hopkins Univ., Baltimore, Md. (USA). Dept. of Geography and Environmental Engineering). Feb 1976. 116p. NTIS $5.50.

Prepared in cooperation with Johns Hopkins Univ., Baltimore, Md. Dept. of Geography and Environmental Engineering. See also rept. dated Jul 1976, PB—255727.

The report, on Project 49-1, covers the final 8-month period of the project, which was initiated in 1963. Among the topics reported are the design, construction and calibration of a test flume to study the interaction of fish species with cooling water systems intakes; laboratory and field experiments to determine impact of entrainment on zooplankton populations; a workshop on biofouling control procedures and their ecological effects; a study of the natural mortality rate of striped bass eggs; development of containment structural for studying the response of phytoplankton populations to perturbations; and the application of a mathematical model to study the effect of algal destruction on dissolved oxygen concentrations. (GRA)

40449 **Zooplankton populations in a polluted, tropical embayment.** Youngbluth, M.J. (Univ. of Puerto Rico, Mayaguez). *Estuarine Coastal Mar. Sci.;* **4**: No. 5, 481-496(Sep 1976).

During 1973—74 biweekly collections of zooplankton were made at three sites in Guayanilla Bay, Puerto Rico: the intake and receiving waters of a fossil-fueled power plant and in the entrance to the bay. The zooplankton ranged from 74 to 5407 organisms/m^3. Densities increased two-to-eightfold several times during the study. The largest variations were associated with seasonal wind and rainfall patterns and reflect the short generation times of the dominant species, the copepod Acartia tonsa and the naupliar larvae of the barnacle Balanus amphitrite. Water movements and thermal pollution accounted for regional differences in density and species composition. Zooplankton were more abundant and diverse at the entrance to the embayment where bay and coastal waters mix. Smaller concentrations and numbers of species characterized the assemblages in the shallower intake waters. Consistently lower densities, fewer species and sporadic increases in abundance characterized the zooplankton found in the thermal cove.

PLANTS

REFER ALSO TO CITATION(S) 40719

INVERTFBRATES

REFER ALSO TO CITATION(S) 40449

40450 **Effect of temperature and salinity on extension of siphons by Mercenaria mercenaria.** Van Winkle, W. (Oak Ridge National Lab., TN); Feng, S.Y.; Haskin, H.H. *J. Fish. Res. Board Can.;* **33**: No. 7, 1540-1545(Jul 1976).

Extension of siphons was used as a criterion of activity to examine the response of the quahog clam, Mercenaria mercenaria, to various combinations of test and acclimation temperatures and salinities. A quadratic regression model for the percentage of clams active as a function of the test temperature and salinity was assumed, and response surface contours for various percentages of activity were calculated and plotted. The regression model accounted for 72 to 88% of the observed variability in the 13 experiments considered. The contours are hyperbolic instead of elliptical for five of the experiments; no biologically meaningful estimates of the lower and upper temperature and salinity limits can be obtained in such cases. Low levels of activity, even at optimal T-S combinations, occurred during the summer. Some of the observed shifts in the position and shape of the temperature-salinity response surfaces were expected in light of shifts in acclimation temperature or salinity. Other shifts in response surface could not be accounted for. The implications of these results for the purification of quahog clams harvested from polluted waters are discussed.

40451 **Temperature dependence of food intake, ammonia excretion, and respiration in Ceriodaphnia reticulata (Jurine)(Lake Kinneret, Israel).** Gophen, M. (Kinneret Limnological Lab., Tiberias, Israel). *Freshwater Biol.;* **6**: No. 5, 451-455(Oct 1976).

The abundance of Ceriodaphnia reticulata (Jurine) in Lake Kinneret is restricted every year to the period March to June with a peak in May. The most constant parameter accompanying the peak is temperature with a range of 20 to 22°C. An attempt was made to clarify whether the estival high average temperatures observed in the epilimnion of this lake (27 to 28°C) could explain the decrease of the Ceriodaphnia population. Three physiological parameters: food intake, ammonia excretion and respiration rates, were measured experimentally at three temperatures (15, 22 and 27°C). The dry weight of individuals of the winter and summer populations were measured, and the percentages of egg-bearing females in the populations were calculated. It was found that temperature increase accelerates the rates of ammonia excretion and food ingestion. The acceleration was greater in the lower temperature range (15 to 22°C) than in the higher one (22 to 27°C). Conversely, the enhancing of respiration rate is higher in the upper temperature range. The resulting deficit of energy at high temperatures causes a reduction in body size and a significant diminution of egg production, which leads to a progressive decline of the population.

VERTEBRATES

40452 **Reason for the formation of additional rings on the scales of the pelyad, Coregonus peled, and the broad whitefish, Coregonus nasus.** Zolotavina, L.A.; Mukhachev, I.S. (Siberian Territorial Administration of Fisheries, Tyumen, USSR). *J. Ichthyol. (Engl. Transl.);* **16**: No. 1, 157-163(1976).

Observations were carried out in 1966 to 1970 on Lake Kuchak for the purpose of establishing the reasons and the time of the formation of additional rings on the scales of the pelyad and the broad whitefish. During the first year of life, the number of sclerites on the scales of the whitefish amounted to 37-38, with an average radius of 3.6 mm. At the age of 19 mo the number of sclerites averaged 63-64, and at age 2+ the average number was 87. The scales of a 3-year fish gave the impression that the fish was 5 or not less than 4 years old. It was concluded that additional rings on the scales are connected with cessation of feeding of the fish when the water is at its hottest in July (above 24°); that the number of sclerites formed in 1 yr differs in the pelyad and the broad whitefish; and specific data on the number of sclerites forming in 1 yr enable the real age of the fish to be more accurately determined. (CAJ)

40453 **Changes in the energy balance of Tilapia mossambica in relation to temperature and ration size.** Mironova, N.V. (Zoological Inst., Leningrad). *J. Ichthyol. (Engl. Transl.);* **16**: No. 1, 120-129(1976).

The energy balance of Tilapia mossambica of different age groups maintained with inadequate food and with food in excess, and under diverse temperature conditions, was calculated for the purpose of studying the dependence of growth rate on environmental conditions. Changes in the consumption and assimilation of food, expenditure on metabolism and increment and the coefficients of utilization of food for growth in relation to these factors were followed up. It was found that assimilability of food increases with the increase in the age of the fish and with an increase in temperature; when the fish are fed to excess, assimilability decreases by comparison with assimilability in the case of restricted feeding. The temperature most favorable for growth changes with the age of the fish. A stimulation in growth is observed prior to the onset of sexual maturity at an increase in temperature from 22 to 31°. In fish which have attained sexual maturity, the temperature most favorable for growth decreases gradually. With a deficiency of food the decrease in the temperature most favorable for growth occurs at an earlier age.

40454 **Formation of a local population of bream, Abramis brama orientalis, in the heated water zone of Konakovo power station.** Sappo, G.B. *J. Ichthyol. (Engl. Transl.);* **16**: No. 1, 35-45(1976).

Ecological and morphological changes are revealed in the bream, Abramis brama orientalis, from various regions. The formation of a local population in the warm water zone of Ivan'kovo reservoir is discussed. Changes in the structure of the pharyngeal teeth in bream from the zone strongly affected by the warm water discharged from Konakovo power station are recorded.

40455 **Rate of propagation of a stimulus through the olfactory nerve fibers and the responses elicited in the rhinencephalon of fishes under changing temperature conditions.** Flerova, G.I.; Gdovskii, P.A. (Inst. of Biology of Inland Waters, Borok, USSR). *J. Ichthyol. (Engl. Transl.);* **16**: No. 1, 106-112(1976).

The rate of propagation of the action potential of the olfactory nerve is determined and the changes occurring in the form of a response elicited in the olfactory bulb by electrical stimulation of this nerve within a temperature range of 0.4 to 25° are shown in the perch, Perca fluviatilis, acclimated to a temperature of 13 to 14°. The form of the responses elicited is most profuse and well reproduced at a temperature several degrees lower than the acclimation temperature.

40456 **Metabolic rate of the underyearling of the carp, Cyprinus carpio, adapted to different water temperatures.** Korovin, V.A. (Siberian Research and Technical Planning Inst. for Livestock Breeding, Novosibirsk, USSR). *J. Ichthyol. (Engl. Transl.);* **16**: No. 1, 168-172(1976).

The metabolic rate in young carp adapted to both low and high water temperatures depends on the thermal regime of the body of water. With a graduated increase in temperature, temperature

ranges are recorded in which the metabolism of underyearlings from the "warm" and "cold" groups is most stable. These ranges correspond to the temperatures at which the fish were kept prior to the experiment. As a result of the considerable plasticity of the carp, its physiologically acceptable temperature limits are fairly wide. The adaptation temperature zone in underyearlings physiologically prepared for wintering, shifts after a short-term adaptation (7 days) to a higher temperature. The influence of adaptation on the survival of young carp under conditions of hyperthermia, is sufficiently clearly traced. Thermal death in fishes adapted to a temperature of 16 to 18°, occurs at a water temperature 4° higher than that at which it occurs in "cold" fishes. In the selection of local carp, the selection for resistance to cold and heat probably needs to be made at a higher level, since instances of an increase or decrease of temperature to nearly critical levels for carp are not uncommon in Siberian waters.

40457 Preferred, avoided, and lethal temperatures of fish during rising temperature conditions. Cherry, D.S. (Virginia Polytechnic Inst. and State Univ., Blacksburg); Dickson, K.L.; Cairns, J. Jr.; Stauffer, J.R. *J. Fish. Res. Board Can.;* **34**: No. 2, 239-246(Feb 1977).

Selected temperatures increased for 15 fish species in a laboratory gradient when acclimated to 3°C increments from 12 to 27°C. Temperature preferences exceeded acclimation temperatures between 12 to 27°C for all except the telescope shiner (Notropis telescopus), yellow perch (Perca flavescens), rainbow trout (Salmo gairdneri), brown trout (Salmo trutta), and brook trout (Salvelinus fontinalis). At 30, 33, or 36°C acclimation, preferred temperatures were less than the acclimation temperature. The highest temperature preferences occurred at acclimations of 27, 30, or 33°C. Bluegill (Lepomis macrochirus), spotted bass (Micropterus punctulatus), rockbass (Ambloplites rupestris), and the spotfin shiner (Notropis spilopterus) consistently selected the highest temperatures while the lowest temperatures were preferred by the salmonids. Final temperature preferences were usually greater than 29°C for most centrachids, above 24°C for most cyprinids, and less than 19°C for salmonids. Avoidance temperatures increased as acclimation temperatures increased. Upper avoidances tested at high acclimation temperatures (30 to 36°C) either equalled or exceeded the 7-day upper lethal temperature limit of the species by 1 to 2°, while avoidances were below this upper lethal limit when tested at the acclimation temperature closest to the species' final temperature preference.

40458 Relationship of sea surface temperature to American and European lobster landings. Dow, R.L. (Dept. of Marine Resources, Augusta, ME). *J. Cons. Int. Explor. Mer;* **37**: No. 2, 186-191(Feb 1977).

Analyses of sea surface temperature and lobster landings data in which there are highly significant correlation coefficients between (1) temperature at Boothbay Harbor, Maine, USA, and Torungen, Aust Agder, Norway, from 1905 to 1974; (2) Maine landings of American lobsters and total European lobster landings from 1950 to 1972; (3) Boothbay Harbor temperature and Maine landings; and (4) Boothbay Harbor temperature and total European lobster landings during the same period, support the assumption that the cyclic increase and decline in landings of both species can be attributed to the same factors; corresponding cyclic increases and declines in temperature and, as has been demonstrated for northern New England and the Canadian maritimes, evidence of overfishing.

40459 Thermal preference in relation to salinity in the threespine stickleback, Gasterosteus aculeatus L., with an interpretation of its significance. Garside, E.T.; Heinze, D.G.; Barbour, S.E. (Dalhousie Univ., Halifax, Nova Scotia). *Can. J. Zool.;* **55**: No. 3, 590-594(Mar 1977).

Thermal preferences were determined in spacious thermal gradients of fresh water and sea water (32‰ salinity (S)) for acclimations of 5, 15, and 25°C in sea water, for samples of threespine stickleback Gasterosteus aculeatus L. Preferred temperatures increased through acclimations of 5 to 25°C, with those for the freshwater tests being about 2°C lower at each acclimation. Final preferenda were 16 and 18°C for freshwater tests and seawater tests, respectively. The final preferendum in such haloplastic species is defined as the highest obtainable preferendum that equals acclimation temperature. A later series of disjunct preference determinations in approximately isosmotic water (10.5%S) for subjects acclimated to 7, 15, and 20°C yielded mean values of 17.7, 18.2, and 18.7°C, respectively. A final preferendum has not been designated since the samples were of separate origins. A parallel exists between these responses and the response of this and other haloplastic species in the determination of upper lethal temperatures. The immediate cause appears to be differentials in metabolic loading occasioned by osmoregulative stresses.

CHEMICALS METABOLISM AND TOXICITY

CELLS

40460 (ORNL-tr—4325) Toward an understanding of the action of certain mutagens of DNA in human cells. Zasukhina, G.D.; Sinelushikova, T.A. Translated by L. Kobylenski from *Dokl. Akad. Nauk SSSR;* **230**: No. 3, 719-721(1976). 4p. P 02/MF A01.

Human and mammalian cells have the capability to restore single strand breaks of DNA by physical and chemical means. Particular attention is being paid to the ability of cells to repair damages induced by chemical elements, since these may contaminate the environment. The action of ethylenimine and cadmium chloride on DNA on cultured human lymphocytes is reported.

40461 Inhibitor of the platelet release reaction. Steiner, M.; Anastasi, J. (Brown Univ., Providence). *J. Clin. Invest.;* **57**: 732-737(Mar 1976).

Formation of lipid peroxides rises sharply when platelets undergo the release reaction. In this study the in vitro effect of vitamin E on platelet aggregation was investigated. α-Tocopherol, an antioxidant of known inhibitory action on lipid peroxidation, was added to platelet suspensions in concentrations up to 1.5 mM. A dose-dependent reduction in platelet aggregation was observed, with complete inhibition of the secondary wave of aggregation at greater than or equal to 0.9 mM α-tocopherol. The inhibitory effect of α-tocopherol on the platelet release reaction was further documented by the decrease in aggregation-induced release of [^{14}C]5-hydroxytryptamine from prelabeled platelets and by the reduction of N-acetylglucosaminidase activity released into the medium. The sharp rise in lipid peroxides normally associated with platelet aggregation was markedly reduced by α-tocopherol and also by acetylsalicylic acid, a known inhibitor of the platelet release reaction. In vivo studies examined the effect of oral vitamin E administration (1,200 to 2,400 IU daily) on plasma and platelet levels to α-tocopherol. Up to 1,800 IU daily, increasing dosages of vitamin E resulted in increasing concentrations of α-tocopherol in plasma and platelets, but intake of vitamin E in excess of this dosage failed to show any further increase in plasma or platelet levels.

PLANTS

REFER ALSO TO CITATION(S) 40126, 40165, 40219, 40333, 40475

40462 Nitrogen nutrition of Myriophyllum spicatum: variation of plant tissue nitrogen concentration with season and site in Lake Wingra . Nichols, D.S.; Keeney, D.R. (Univ. of Wisconsin, Madison). *Freshwater Biol.;* **6**: No. 2, 137-144(Apr 1976).

Samples of water, sediment and Myriophyllum spicatum were collected from four weedbed sites in Lake Wingra, a small hypereutrophic hardwater lake in Madison, Wisconsin, several times during the 1972 and 1973 growing seasons, and analyzed for various forms of N. The concentrations of inorganic N in the lake water were quite similar at all sites. The differences in the total N content of the Myriophyllum tissue from site to site directly related to the levels of available sediment N, indicating a dependence upon the sediment as a N source. Myriophyllum tissue N concentrations (ash and moisture-free basis) were highest in spring, decreased steadily during the summer, and increased again in the fall. Myriophyllum apparently grows very little during the winter, but continues to accumulate N. The death and decay of a considerable portion of the Myriophyllum in the fall contributes insignificant amounts of N directly to the lake water. Nitrogen does not appear to be limiting Myriophyllum spicatum growth in Lake Wingra.

40463 Effects of lead on algae. IV. Effects of Pb on respiration and photosynthesis of Phaeodactylum tricornutum(Bacillariophyceae). Woolery, M.L.; Lewin, R.A. (Univ. of California, San Diego). *Water, Air, Soil Pollut.;* **6**: No. 1, 25-31(Aug 1976).

Lead inhibits respiration and photosynthesis in Phaeodactylum. In cells treated for 24 h with $PbCl_2$ (10 mg l^{-1}), photosynthesis is completely suppressed, while respiration is reduced to 25%. A lower concentration, 1.0 mg l^{-1}, permits photosynthesis at 75% of the control rate, respiration being virtually unaffected. The vital activities of cells treated for 48 h or 72 h are progressively more inhibited: concentrations of $PbCl_2$ as low as 0.1 mg l^{-1} reduce photosynthesis and respiration by 25 to 50%.

40464 Combined effect of sulfur dioxide and ozone on bean and tobacco plants. Jacobson, J.S.; Colavito, L.J. (Inst. for Plant Research, Yonkers, NY). *Environ. Exp. Bot.;* **16**: No. 4, 277-285(Dec 1976).

Plants of two cultivars of Phaseolus vulgaris L. and one cultivar of Nicotiana tabacum L. were exposed to a replicated series of concentrations of sulfur dioxide (SO_2), ozone (O_3), and combinations of these two air pollutants for single four-hour periods. Experiments were performed in controlled-environment chambers using concentrations of pollutants above and below Federal ambient air

quality standards in order to determine whether interactive effects result from exposure to concentrations of pollutants occurring in some agricultural areas of the United States. Dose—response curves for foliar symptoms were found to approximate logarithmic functions of pollutant concentrations when the frequency of leaf injury was converted into probit units. In bean cultivars, the toxicity of SO_2 or O_3 was either attenuated or not affected when the two pollutants were combined depending on their concentrations. In tobacco, the toxicity of SO_2 or O_3 was either amplified or not affected in the presence of the two pollutants. Concentrations of SO_2 or O_3 that did not exceed the respective U.S. ambient air quality standards significantly altered the incidence of injury caused by the other pollutant. These results demonstrate that interactive effects between SO_2 and O_3 can occur but the magnitude and direction of these effects depend on plant species and concentrations of pollutants.

40465 Somatic crossing over in Glycine max (L.) Merrill: induction of somatic crossing over and specific locus mutations by methyl methanesulfonate. Vig, B.K. (Univ. of Nevada, Reno); Nilan, R.A.; Arenaz, P. *Environ. Exp. Bot.;* **16**: No. 4, 223-234(Dec 1976).

The effect of the alkylating agent methyl methanesulfonate (MMS) was studied on the induction of somatic crossing over and point mutations on leaves of Glycine max using the gene y_{11} in combination with, or without its incompletely dominant allele, Y_{11}. The three types of spots, viz., twins or doubles (dark green—yellow), dark greens (resembling $Y_{11}Y_{11}$ phenotype) and yellows (resembling $y_{11}y_{11}$ phenotype) increase generally in parallel to each other at 0.00625% MMS concentration, or at higher concentrations. MMS becomes less effective as germination advances during the first 24 hr and its effectiveness appears to have no relationship with the onset of DNA synthesis. This holds for both the frequency of spots on the $Y_{11}y_{11}$ as well as $y_{11}y_{11}$ leaves. The spot frequency on the lower surface of leaves, with a larger number of embryonic cells, is only about one-third of all the spots present on the two surfaces. MMS induces a substantial number of mutations of the gene y_{11} yields Y_{11} as revealed by light green spots on $y_{11}y_{11}$ leaves. It is more effective than methyl ethanesulfonate (MES), methyl butanesulfonate (MBS), and ethylmethanesulfonate (EMS). The order of decreasing effectiveness in the soybean system under study appears to be MMS greater than MES greater than MBS (greater than or equal to EMS). This system responds to these compounds in a manner similar to other well analyzed biological systems which further confirms the usefulness of the soybean strains as test systems for new mutagens.

40466 Effect of heavy metals on some aspects of lichen physiology. Puckett, K.J. (Environment Canada, Downsview, Ont.). *Can. J. Bot.;* **54**: No. 23, 2695-2703(1 Dec 1976).

The effect of the heavy metals cadmium, cobalt, copper, lead, mercury, nickel, and silver on the lichen Umbilicaria muhlenbergii (Ach.) Tuck. is described in terms of membrane integrity, chlorophyll damage, and changes in photosynthetic ^{14}C fixation. Increasing concentrations of copper, mercury, and silver produced a gradual potassium loss from the thallus while the other metals tested initiated an abrupt efflux at a specific concentration. Copper, mercury, and silver caused both a displacement and a decrease in the absorption spectrum of chlorophyll, whereas no detectable changes were induced by the other metals. The relative toxicities of these metals on photosynthesis is reflected in the series Ag, Hg < Co < Cu, Cd < Pb, Ni for short-term exposures, and Ag, Hg < Cu greater than or equal to Pb, Co < Ni for extended exposures. The tendency for the metals studied to fall into two distinct groups on the basis of their effects on lichen metabolism is discussed in terms of their physicochemical properties. (auth)

40467 Effect of lead, cadmium, arsenate, and fluoride ions on the growth and fine structure of Sphagnum nemoreum in aseptic culture. Simola, L.K. (Univ., Helsinki). *Can. J. Bot.;* **55**: No. 4, 426-435(15 Feb 1977).

The growth of Sphagnum nemoreum Scop. and the fine structure of its leaf cells were studied in aseptic cultures to which were added lead, cadmium, arsenate, and fluoride (0.001, 0.01, 0.1, and 1 mM solutions). The highest concentration having no or almost no effect on the dry weight was 0.1 mM for lead, 0.01 mM for fluoride and cadmium, and 0.001 mM for arsenate. The 1 mM solution of Na_2HAsO_4 and 0.1 mM solution of $CdSO_4$ were toxic and the inocules died rapidly. The 1 mM solutions of KF and $Pb(NO_3)_2$ were growth-retarding. The chloroplasts tended to accumulate starch when arsenate (0.1 mM) was added to the medium. Fluoride promoted the development of plastoglobuli, and lead (0.1 mM) promoted lipid accumulation in the cytoplasm. High concentrations of arsenate and fluoride inhibited the differentiation of hyaline cells. The physiological and ecological effects of these substances have been discussed with special reference to the problem of pollution.

INVERTEBRATES

REFER ALSO TO CITATION(S) 39245, 39249, 40242

40468 Cadmium and other heavy metals in sea-skaters (Gerridae: Halobates, Rheumatobates). Cheng, L. (Univ. of California, San Diego, La Jolla); Alexander, G.V.; Franco, P.J. *Water, Air, Soil Pollut.;* **6**: No. 1, 33-38(Aug 1976).

Exceptionally high concentrations of Cd (100 to 200 ppM dry weight) were found in samples of Halobates collected off Baja California. In contrast, no detectable Cd was found in Rheumatobates collected from mangrove lagoons in the Gulf of California. Concentrations of five other heavy metals in the two marine insects are also presented.

40469 Uptake of copper by the polychaete Cirriformia spirabrancha in the presence of dissolved yellow organic matter of natural origin. Milanovich, F.P.; Spies, R.; Guram, M.S.; Sykes, E.E. (Univ. of California, Livermore). *Estuarine Coastal Mar. Sci.;* **4**: No. 5, 585-588(Sep 1976).

The toxicity of copper to the marine worm Cirriformia spirabracha was investigated and its accumulation in the tissues was determined. Dissolved yellow organics (yellow substance) were shown to have no effect on the rate of copper uptake by the worms in seawater media. Discussions as to the possible implication of these results are presented.

VERTEBRATES

REFER ALSO TO CITATION(S) 39247, 40232, 40242, 40310, 40445

40470 (UCRL—13701) **Preliminary toxicological studies of TATB, TCB, and TCTNB. Final report.** Jorgenson, T.A.; Simmon, V.F.; Dilley, J.V. (Stanford Research Inst., Menlo Park, Calif. (USA)). Sep 1976. Contract W-7405-ENG-48; PO-9305705. 37p. P 03/MF A01.

The acute oral LD50s for TATB and TCTNB in both sexes of rats and mice were greater than 5 g/kg. TCB had the following LD50s: 1800 mg/kg in male rats, 2800 mg/kg in female rats, 3350 mg/kg in male mice, and 3402 mg/kg in female mice. Primary skin irritation studies in the rabbit showed that TCB and TCTNB were mildly irritating and that TATB was nonirritating. Eye irritation studies, also in the rabbit, showed that TCB and TATB were mild but transitory irritants, with TCTNB responding as a severe irritant. The sensitization study in the guinea pig did not show TATB, TCB, or TCTNB to be sensitizers. TCTNB, TATB, and TCB were not mutagenic when tested in five strains of Salmonella typhimurium and in Escherichia coli strain WP2. TCTNB was the most toxic of the three compounds tested in these strains, and it also showed toxic effects in the recombination-deficient Bacillus subtilis strain M45. None of the compounds showed toxic effects in repair-deficient E. coli strain p3478. Mitotic recombination in the yeast S. cerevisiae D3 was increased by TCB but not by TCTNB or TATB; however, a dose-related response could not be established. The response of rats exposed for 1 hour to saturated TCB vapor indicates that TCB does not present an acute inhalation hazard. The only noteworthy observation was that the rate of weight gain for the treated group was less than that of the controls. The results indicated that TATB is not an acute inhalation hazard as a dust.

40471 (ORNL-tr—4343) **Question of the effect of metaphenylendiamine on certain internal organs and the nervous system.** Kachalay, D.P.; Orlov, N.S.; Myannik, L.E.; Ivanchenko, A.M.; Venetskaya, F.V.; Grushevskaya, N.Yu. Translated by S.D. Blalock Jr. from *Farmakol. Toksikol. (Kiev);* No. 8, 180-183(1973). 4p. P 02/MF A01.

Metaphenylendiamine (M-PDA) is a chemical compound classed in the group of aminonitro derivatives of the aromatic series and is a water soluble crystalline substance. It is employed in the manufacture of dyes and lacquers. It penetrates the body through the respiratory passages, the skin, and through the gastrointestinal tract when swallowing saliva. Inasmuch as there is no information on the effect of subtoxic doses of M-PDA on the bodies of animals and man in the accessible literature, we studied the effect of M-PDA in doses of 28, 14, and 5.6 mg/kg (which corresponds to 1/10, 1/20, and 1/50 of LD_{50}) in a four-month experiment performed on albino rats. Results are reported.

40472 (BNWL-tr—235) **Morphological changes of the nasal mucous membrane in experimental animals during micromercurialism and the influence of hydrogen sulfide—carbon dioxide inhalations.** Shaparenko, B.A.; Sheinin, P.I.; Lastkov, O.A.; Foderman, V.M.; Drevnyak, N.S. Translated from *Zh. Ushnykh Nosovykh Gorlovykh Bolez.;* **33**: No. 4, 37-39(1973). 5p. P 02/MF A01.

In rats exposed to mercury vapors, signs of chronic catarrhal inflammation of the nasal mucosa appeared during the second month of the experiment. After five months a pronounced chronic hyperplastic inflammation developed in the animals. A one-month recuperative period proved insufficient for the nasal mucosa to return to normal. The prophylactic and therapeutic use of hydrogen sulfide-carbon dioxide inhalation during mercury-vapor poisoning was found to reduce the intensity of inflammatory changes in the mucous membrane of upper respiratory passages. Prolonged simultaneous

exposure to metallic mercury vapors and hydrogen sulfide led to a pronounced chronic hyperplastic inflammation of the upper-respiratory mucous membrane.

40473 (BNWL-tr—237) **Effect of trace metals on disturbances in acid-base equilibrium and mineral economy in subacute hydrogen sulfide poisoning.** Kosmider, S.; Rogala, E.; Szulik, Z.; Dwornicki, J. Translated from *Patol. Pol.;* **24**: No. 1, 171-186(1973). 20p. P 02/MF A01.

Disturbances in mineral economy, acid-base equilibrium and histochemical disturbances in the kidneys were found in animals poisoned with hydrogen sulfide. The beneficial effect of prophylactic administration of trace metals in the form of Vitaral in the course of the poisoning, resulting in reversal of mineral disturbances, acid-base equilibrium, and disappearance of metabolic disturbances in the kidneys was demonstrated. It was confirmed in vitro that the mechanism of the toxic action of hydrogen sulfide consists in the combination of the latter with alkali metals to form sulfides, leading to the elimination of metals as activators of many enzymes.

40474 Acidification of lakes in Canada by acid precipitation and the resulting effects on fishes. Beamish, R.J. (Dept. of the Environment, Nanaimo, British Columbia). *Water, Air, Soil Pollut.;* **6**: No. 2/3/4, 501-514(1976).

In the Sudbury region of Ontario, Canada, fallout of sulfur oxides has been shown to be responsible for damage to vegetation, lakes and fishes. The acidic fallout has been shown to effect a rate of acidification in many lakes that over several decades has resulted in the extinction of many species of fishes. Fish exhibit profound differences in acid tolerance but show some similarities in their physiological response to levels within the range of their individual susceptibilities. Prior to extinction most females of a particular species did not release their ova to be fertilized. The failure of females to spawn was coincident with an inability to maintain normal serum Ca levels. In some species growth was reduced despite an adequate supply of preferred food items. High concentrations of acid were considered to be the principal factor stressing the fish populations. Elevated concentrations of some heavy metals may add to the stress caused by high concentrations of acid.

40475 Presentation of the Norwegian project "Acid Precipation: Effects on Forest Fish". Overrein, L.N. *Water, Air, Soil Pollut.;* **6**: No. 2/3/4, 167-172(1976).

The joint research project, "Acid Precipitation--Effects on Forest and Fish" (the SNSF-project) of the Agricultural Research Council of Norway and the Norwegian Council for Scientific and Industrial Research was started in 1972. The objectives of the project are to: (1) establish as precisely as possible the effects of acid precipitation on forest and freshwater fish; and (2) investigate the effects of air pollutants on soil, vegetation, and water, required to satisfy point 1. Research activities on the project are organized and carried out mainly at four institutes. Within and between these institutes groups are formed carrying out investigations in fields including atmospheric transport and chemistry, dry deposition and leaching of foliage, forest growth, soil biology and soil chemistry, hydrological relationships of peatland, hydrobiology with special stress on fish, and hydrochemistry including snow chemistry.

40476 Environmental dependence of manganese and zinc in the scales of Atlantic salmon, Salmo salar (L) and Brown trout, Salmo trutta (L). Abdullah, M.I.; Banks, J.W.; Miles, D.L.; O'Grady, K.T. (Univ. of Liverpool). *Freshwater Biol.;* **6**: No. 2, 161-166(Apr 1976).

Analysis of manganese and zinc concentrations in the scales of salmon and trout from a number of sites showed significant dependence of the levels of these metals in the scales on the levels in the environment. There is some evidence to suggest that in trout scales there is a minimum concentration of zinc above which there is a direct proportion between environmental and scale concentration. It is also possible that the response of trout to environmental zinc differs from that of salmon.

40477 Comparisons of antidotal efficacy of chelating drugs upon acute toxicity of Ni(II) in rats. Horak, E.; Sunderman, F.W. Jr.; Sarkar, B. (Univ. of Connecticut, Farmington). *Res. Commun. Chem. Pathol. Pharmacol.;* **14**: No. 1, 153-165(May 1976).

Six chelating drugs were administered to rats by im injection at equimolar dosages in order to compare their relative effectiveness in prevention of death after a single parenteral injection of $NiCl_2$. Triethylenetetramine and d-penicillamine were the most effective antidotes for acute Ni(II)-toxicity. In order of decreasing antidotal effectiveness, diglycyl-L-histidine-N-methylamide, sodium diethyldithiocarbamate and calcium disodium versenate significantly reduced the acute mortality of rats following ip injection of Ni(II). α-Lipoic acid was not effective as an antidote for acute Ni(II)-toxicity.

40478 Cadmium and zinc toxicity to flagfish, Jordanella floridae. Spehar, R.L. (Environmental Protection Agency, Duluth, MN). *J. Fish. Res. Board Can.;* **33**: No. 9, 1939-1945(Sep 1976).

Cadmium and zinc toxicity to the flagfish was determined on the basis of 96-h median lethal concentrations (LC50) and significant decreases in survival, growth, and reproduction over the complete life cycle of the fish. The 96-h LC50 values for cadmium and zinc to juvenile flagfish were 2500 and 1500 μg/liter, respectively. In chronic tests, reproduction was the most sensitive indicator of cadmium toxicity and was inhibited at 8.1 μg/liter. Tissue-concentration analysis showed that fish exposed to concentrations of 1.7 μg/liter and above accumulated significantly greater amounts of cadmium than those in the controls. In zinc tests, survival of larvae (not exposed as embryos) and growth of females were the most sensitive measure of zinc toxicity. Significant uptake of zinc occurred in fish exposed to concentrations of 47 μg/liter and above. The lowest cadmium and zinc concentrations causing adverse effects to the flagfish were similar to those affecting other fish species.

40479 Long-term effects of methylmercuric chloride on three generations of brook trout (Salvelinus fontinalis): toxicity, accumulation, distribution, and elimination. McKim, J.M.; Olson, G.F.; Holcombe, G.W.; Hunt, E.P. (Environmental Protection Agency, Duluth). *J. Fish. Res. Board Can.;* **33**: No. 12, 2726-2738(Dec 1976).

During a 144-wk period three generations of brook trout (Salvelinus fontinalis) were continuously exposed to mean water concentrations of methylmercuric chloride (MMC) of 2.93. 0.93, 0.29, 0.09, 0.03, and less than 0.010 (control) μg Hg/liter. During the first 39 wk the highest concentration (2.93 μg Hg/liter) produced deformities and 88% mortality of first-generation adults. At an MMC concentration of 0.93 μg Hg/liter, second-generation trout developed deformities and all but one female died during the 108-wk exposure. The maximum acceptable toxicant concentration (MATC) for brook trout exposed to MMC in this water with a hardness of 45 mg/liter (as $CaCO_3$) and a pH of 7.5 fell between 0.93 and 0.29 μg Hg/liter. The mean 96-h LC50 for yearling (200 g) and 20-wk-old (12 g) juvenile brook trout exposed to MMC was 75.0 μg Hg/liter. The accumulation rate of mercury by eight selected tissues of first-generation trout exposed to MMC was relatively rapid at all MMC concentrations tested. The blood, spleen, and kidney accumulated mercury most rapidly and contained the highest residues in both first- and second-generation trout followed by liver, gill, brain, gonad, and muscle in order of decreasing mercury residues. Monomethylmercury made up 90 to 95% of the total mercury present in muscle, the only tissue analyzed for this compound. Mean muscle residues in first-generation trout, dying after 16 to 28 wk of exposure to 2.93 μg Hg/liter and in second-generation trout, dying after 64 to 100 wk of exposure to 0.93 μg Hg/liter, were 23.5 and 9.5 μg Hg/g, respectively.

40480 Heavy metal enhancement of airway sulfate absorption in the perfused rat lung. Charles, J.M.; Menzel, D.B. (Duke Univ. Medical Center, Durham, NC). *Res. Commun. Chem. Pathol. Pharmacol.;* **15**: No. 4, 627-639(Dec 1976).

The effect of heavy metal cations in enhancing the absorption of sulfate ions from the airways of the isolated, ventilated and perfused rat lung (IVPL) into the lung vasculature was studied. The cations investigated included Cd^{++}, Co^{++}, Hg^{+++}, Ni^{++}, Fe^{+++}, Mn^{++} and Zn^{++}. The cations increased the sulfate ion absorption from the rat IVPL 199-264 percent as compared to absorption in the presence of Na^+ ions. An exception was Mn^{++}, in which absorption did not differ significantly from the Na^+ control. The uptake of sulfate ions from the vasculature of the IVPL could not be demonstrated.

40481 Long-term cadmium stress in the cunner, Tautogolabrus adspersus. MacInnes, J.R.; Thurberg, F.P.; Greig, R.A.; Gould, E. (National Marine Fisheries Service, Milford, CT). *Fish. Bull.;* **75**: No. 1, 199-203(Jan 1977).

The cunner, Tautogolabrus adspersus, was exposed for 30 and 60 days to 0.05 or 0.10 ppM Cd as cadmium chloride. The mean gill-tissue respiratory rates exhibited by the control fish and those exposed to 0.05 and 0.10 ppM Cd were 972, 736, and 665 μl O_2/h . g dry weight, respectively, after 30 days and 1,036, 702, and 587 μl O_2/h . g, respectively, after 60 days. Changes were also observed in the activities of two liver enzymes, aspartate aminotransferase (depression) and glucose-6-phosphate dehydrogenase (induction). Results are compared with those from other metal-exposure studies with cunners and other teleosts.

MAN

40482 Certain aspects of the hygienic assessment of the combined effect of smoking and air pollution on the organism. Katsnelson, B.A. *Gig. Sanit.;* No. 9, 62-66(1974). (In Russian).

Studies on the combined effect of smoking and air pollution in open air and in workplaces are reviewed for the hygienic assessment of the two different factors. The contribution of polycyclic aromatic hydrocarbons inhaled during smoking to lung cancer may be equivalent to, and even surpass, the contribution of such compounds inhaled in polluted city air. Heavy smoking effaces even statistically significant differences in the incidence of lung cancer between areas

with high and low air pollution levels. Lung cancer mortality increases more rapidly with the number of cigarettes smoked in areas with low pollution than in areas with high pollution level. Epidemiological studies in lung cancer mortality among smoking and nonsmoking asbestos workers revealed potentiation of the carcinogenic effect of benzopyrene present in cigarette smoke by asbestos dust. Many irritating pollutants, such as sulfur dioxide, sensitize the bronchial mucosa to the carcinogenic effect of polycyclic aromatic hydrocarbons. Epidemiological studies revealed that silicogenic industrial dusts potentiate the effect of cigarette smoke carcinogens by facilitating the retention of the latter. High dust concentrations may reduce and even fully eliminate the significant differences in the incidence of chronic bronchitis among smokers and nonsmokers.

40483 (ORNL-tr—4341) **Allergic cystitis of chemical etiology.** Orlov, N.S. Translated by S.D. Blalock Jr. from *Urol. Nefrol.;* **39**: No. 4, 33-36(1974). 4p. P 02/MF A01.

Data in the literature show that allergies of the urinary organs can appear under the effect of chemical antigens from the human environment. In the process of manufacturing synthetic dyes chemicals of the aminonitroderivative group are employed whose influence on the urinary tracts has still not been adequately studied. Such substances include metaphenylenediamine (MPD) which is used in a mixture with other chemicals for dyeing artificial leather and fur, is converted into diisocyanate in mixture with 2,6-toluylendiamine, which is used in the manufacture of plastics, synthetic glue, artificial leather, various lacquers, etc. The allergic effect of MPD on the urinary organs was studied in 112 workers (68 men and 44 women) employed in its production. The age of the subjects was predominantly from 30 to 50 years and working experience ranged from 5 to 10 years. Of the 112 subjects, 15 (6 men and 9 women) complained of dysuria; of these 6 complained of frequent urination and the impossibility of retaining urine for long, 5 of burning and unpleasant sensations at the end of urination, and 4 of cutting pain during urination. Analysis of the case history data indicates the cyclic nature of appearance and aggravation of the indicated complaints: the appearance or enhancement of the complaints during production and the reduction or disappearance of complaints (without treatment) in the period of vacation or interruption in work with MPD. Despite the presence of sharply pronounced dysuria, the antiinflammation treatment carried out in most of the subjects was ineffective but good results were noted with a combination of desensitizing means and antiinflammatory preparations.

40484 **Methylmercury poisoning.** Weiss, B.; Doherty, R.A. (Univ. of Rochester, NY). *Teratology;* **12**: No. 3, 311-313(1975).

Teratogenic effects of methylmercury poisoning are discussed and sensory and motor manifestations are described. The epidemiology is discussed with regard to consumption of bread prepared from methylmercury-treated wheat and consumption of fish exposed to high concentrations of methylmercury. Methods of diagnosis, treatment, and prevention of this disease are briefly discussed. (HLW)

40485 **Soldiers' water vessels as a lead source.** Augustson, J.H. (Norwegian Defence Research Establishment, Kjeller). *Ann. Occup. Hyg.;* **19**: No. 2, 169-171(Nov 1976).

Soldiers in the Norwegian Army and Air Force have used stainless steel water vessels in their standard field equipment since 1950. The canteen, manufactured during World War II, has a low-melting solder on both the inside and the outside. Solders of this kind have, in general, a high lead content and are not uncommon sources of lead uptake among people drinking illicitly distilled whiskey. Acidic solutions, in particular, can release mg-amounts of lead, cadmium, antimony and zinc from the solders within a few hours. In most drinking water the pH lies between 5 and 10. However, it is known that soldiers also store lemonade and juice in the canteens; such drinks have pH values of 2.5 to 4. It would therefore seem necessary to cover a pH range of 2.5 to 10 in an investigation of heavy metal release from canteens. It has been established that the release of lead from lead-containing water pipelines is pH and temperature dependent. Low water-hardness increases the release of lead from pipelines. Release of lead from solders into aqueous media can then be expected to depend on: (1) size of the solder surface; (2) lead content of the solder; (3) properties of the solvent, e.g., acidity, complex-forming properties, calcium content; (4) temperature; and (5) contact time.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

40486 (PB—257138) **An evaluation of selected satellite communication systems as sources of environmental microwave radiation.** Hankin, N.N. (Environmental Protection Agency, Silver Spring, Md. (USA). Office of Radiation Programs). Dec 1974. 67p. (EPA—520/2-74/008). NTIS $4.50.

Selected satellite communication (SATCOM) systems are evaluated analytically and, for some of these systems, through measurement of the microwave radiation power densities generated by them. The evaluation is directed toward assessing the radiation exposure hazards which exist for specific systems and generally for SATCOM systems as a class of high power nonionizing radiation source. The paper includes determinations of anticipated maximum power density levels as functions of distance from the source, a description of the analytical method used, and the results of measurements of the power densities produced by certain SATCOM systems. Included also is a discussion of potential hazard analysis and its uses in identifying systems which may constitute environmental hazards. (GRA)

40487 (PB—257077) **Radiation characteristics of traffic radar systems. Technical note.** Hankin, N.N. (Environmental Protection Agency, Washington, D.C. (USA). Office of Radiation Programs). Mar 1976. 16p. (ORP/EAD—76/1). NTIS $3.50.

The results of measurements and calculations of microwave radiation power density produced by two typical traffic radar systems were reported and discussed in this report. Traffic radar systems are small portable units used by police to determine speed of vehicles relative to that of the police vehicle in which the unit is mounted. It was determined that traffic radars were low-powered devices, incapable of producing environmental levels of microwave radiation greater than 0.01 W/sq m at distances where persons would normally be exposed during use of such systems. Police personnel using the radar system could be exposed to power densities up to 36 W/sq m. For comparison purposes, the threshold for exposure allowed by the OSHA occupational exposure standard is 100 W/sq m for exposure durations of 6 minutes or more. (GRA)

40488 (AD-A—029489) **An experimental investigation of the effect of 1.06 micrometers laser light on the transparent ocular media. Annual report, 1 Apr 1975—29 Feb 1976.** Miller, N.D. (Technology, Inc., San Antonio, Tex. (USA). Life Sciences Div.). Apr 1976. Contract DAMD17-75-C-5040. 61p. (TI—5040-TSA0002). NTIS $4.50.

The effect of 1.06 μ light on the clear ocular media of rabbit eyes was investigated. A Q-switched Nd:YAG laser operating in the TEM sub oo mode was used to irradiate the eyes with 100 msec trains of 300 to 700 nsec pulses at 1 KHz repetition rate. A clouding of the ocular media was observed within 24 hours for multiple exposures with energy levels near retinal damage threshold. The latency for the appearance of the clouding ranged from less than an hour for total doses of 50X retinal damage thresholds to approximately 24 hours for total dose of 2X retinal thresholds. A theoretical study of Mie scattering for known cell and other particle sizes of the ocular media is described in the report. The major findings from slit lamp examinations of the exposed eyes is also described. The slit lamp examinations revealed changes in the lens following exposures that took up to one week to develop. The changes were manifest as an increased scatter from the central third of the lenses. (Author) (GRA)

40489 (AD-A—029430) **Bibliography of reported biological phenomena (effects) and clinical manifestations attributed to microwave and radio-frequency radiation. Supplement number 8. Medical research interim report.** Glaser, Z.R.; Brown, P.F. (Naval Medical Research and Development Command, Bethesda, Md. (USA)). Aug 1976. 27p. NTIS $4.00.

Supplement to report dated May 1976, AD-A—025354.

Almost 350 additional references on the biological responses to radio frequency and microwave radiation, published up to August 1976, are included in this continuing bibliography of the world literature. Particular attention has been paid to the effects of nonionizing radiation on man at these frequencies. The citations are arranged alphabetically by author (where possible), and contain as much information as possible so as to assure effective retrieval of the original documents. Soviet and East European literature is included in detail. (GRA)

40490 (AD-A—029676) **Pulp effects of neodymium laser: a preliminary report. Report for Jan 1975—Aug 1976.** Adrian, J.C. (Army Inst. of Dental Research, Washington, D.C. (USA)). 19 Aug 1976. 13p. NTIS $3.50.

A total of eight teeth from two Rhesus monkeys were exposed to various amounts of Neodymium laser radiation. The pulp response was found to be much less severe than that in a study of 19 teeth previously reported for exposure to similar amounts of ruby laser radiation. If additional studies support this initial finding, it is suggested that a reevaluation of laser mediated procedures in vital teeth be initiated. (GRA)

HEALTH AND SAFETY

40491 (ERDA—76-45/9) **Safety Information System Guide.** Bullock, M.G. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1977. Contract EY-76-C-07-1570. 72p. (SSDC—9). P 05/MF A01.

This Guide provides guidelines for the design and evaluation of a working safety information system. For the relatively few safety professionals who have already adopted computer-based programs, this Guide may aid them in the evaluation of their present system. To those who intend to develop an information system, it will, hopefully, inspire new thinking and encourage steps towards systems safety management. For the line manager who is working where the action is, this Guide may provide insight on the importance of accident facts as a tool for moving ideas up the communication ladder where they will be heard and acted upon; where what he has to say will influence beneficial changes among those who plan and control his operations. In the design of a safety information system, it is suggested that the safety manager make friends with a computer expert or someone on the management team who has some feeling for, and understanding of, the art of information storage and retrieval as a new and better means for communication.

40492 (FDA—77-8016) **Directory of personnel responsible for radiological health programs.** (Department of Health, Education, and Welfare, Rockville, Md. (USA)). Jan 1977. 33p. GPO.

This is a directory of professional personnel who administer the radiological health program activities in state and local governmental agencies. Included in the directory is a listing of each state health officer or the head of the agency responsible for the radiological health program. The name, address, and telephone number of the radiological health personnel are listed, followed by the alternate contact who, in many instances, may be chief of a larger administrative unit of which the radiological health program is a subunit. The address for the program is also included if it differs from the official health department or agency. Generally, the titles of the personnel listed will indicate the administrative status of the radiological health program. The directory also includes a list of key professional personnel in the Bureau of Radiological Health, Radiation Operations Staff, Regional Radiological Health Representatives, Winchester Engineering and Analytical Center, Food and Drug Administration; Office of Radiation Programs, Regional Radiation Representatives, National Environmental Research Center, and Eastern Environmental Radiation Laboratory, Environmental Protection Agency; selected personnel in the U.S. Nuclear Regulatory Commission; and selected personnel in the National Bureau of Standards.

40493 (LA—6671-M) **Guide to industrial respiratory protection.** Pritchard, J.A. (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1977. Contract W-7405-ENG-36. 158p. P 08/MF A01.

The Occupational Safety and Health Act of 1970 has increased the emphasis on proper selection and use of respirators in situations where engineering controls are not feasible or are being implemented. Although a great deal of information on respiratory protection has been published, most of it is more technical than necessary for the average user faced with day-to-day problems of respiratory protection in industrial environments. This Guide is to provide the industrial user a single reference source containing enough information for establishing and maintaining a respirator program that meets the OSHA requirements outlined in 29 CFR Part 1910.134. It includes chapters on respirator selection, use, maintenance, and inspection, a complete description of all types of respirators and their advantages and limitations, and chapters on respirator fitting and wearer training, respiratory physiology, respiratory hazards, and physiological and psychological limitations. Also included are samples of the decision logic used in respirator selection, guidance on setting up an adequate respirator program through formulation of written standard operating procedures, and discussion of the meaning of the approved respirator.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 39185, 39233

40494 **Numerical simulation of singly dispersive convection in groundwaters.** Rubin, H. (Univ. of Florida, Gainesville); Greif, S. pp 336-342 of In Proceedings of the 1976 summer computer simulation conference. La Jolla, CA; Simulation Councils, Inc. (1976).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

See CONF-760703—.

In some groundwater aquifers geothermal activity may lead to thermal convection. In such cases, the horizontal flow in the aquifer obtains upward and downward components leading to significant changes in the transport phenomena in groundwater. There is an hypothesis that such a mechanism does exist in the Floridan aquifer, but its deep zone is extremely cavernous. Therefore, even very slow motions may lead to an intensive dispersion of heat, as well as turbulent and inertial effects, demonstrated by the invalidity of Darcy's laminar law. The finite difference approach was applied to simulation of the flow conditions, in such an aquifer, subject to convection motions. A combination of the SOR and ADI, applied to a moving coordinate system, was found to be practical up to R/R_0 approximately equal to 6. The formation of boundary layers at the top and bottom of the aquifer, and also the production of terms having convection characteristics, reduce the applicability of these methods at high Rayleigh numbers.

40495 **An experimental study of two-phase convection in a porous medium with applications to geological problems.** Sondergeld, C.H.; Turcotte, D.L. (Department of Geological Sciences, Cornell University, Ithaca, New York 14853). *J. Geophys. Res.;* **82**: No. 14, 2045-2053(10 May 1977).

Experimental studies of two-phase thermal convection in a porous medium have been carried out in a sandbox. An initially water-satured porous layer was heated from below and cooled from above. When the lower boundary of the layer reached 100degree C, a two-phase steam-water zone developed. The variable parameters in this study were the thickness of the porous layer and the heat flux. Measurements indicated that there can exist a stable form of two-phase convection in a porous medium. Polyhedral convection cells were observed in the water-saturated zone above the two-phase zone. The dimensions of the cells varied with the heat flux for a given thickness. The two-phase region was of variable geometry and had a distinctly nonhorizontal steam-water interface with the overlying water zone. Convective instabilities were initiated by the occurrence of the phase change. At high heat fluxes a dry steam zone developed in which temperatures exceeded 110degree C. The dry steam zone was located close to the base plate with a wet steam zone above. A one-dimensional heat and mass transfer model is used to analyze the experimental data. The results are compared to observations made on vapor-dominated geothermal systems and applied to some mineralization problems.

GEOPHYSICS

GEOPHYSICAL SURVEY METHODS

40496 (USGS-OFR—418) **Field experiments to test neutron interaction techniques in boreholes in relatively dry, low porosity rock.** Senftle, F.E.; Moxham, R.M.; Tanner, A.B.; Philbin, P.W.; Boynton, G.R.; Wager, R.E. (Geological Survey, Reston, Va. (USA)). 1976. 51p. TIC.

Depending on the technique, there are a number of problems associated with in situ neutron activation elemental analyses in boreholes. Several techniques of using delayed and capture gamma rays for in situ borehole spectral analysis were tried in a relatively dry gabbro. Using copper as a test element, the best results using a delayed gamma-ray method were obtained by independent uniform neutron irradiation of the borehole followed by a delay time of about 16 hours before spectral analysis. The results obtained for several other elements measured by both delayed and capture gamma-ray methods, however, showed poor correlation with the chemical analyses. The change in the nonthermal compared with thermal neutron flux density in the rock appears to be the most serious cause of the poor correlation observed. This in turn affects the gamma-ray peak intensities and energies. Errors in the driller's log, poor correspondence between the core chemistry and the sample, and interstation interference also contributed substantially to the poor results. (auth)

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

40497 (TID—27554) **Structural response governing hydraulic fracturing operations in rock media. Final report.** Advani, S.H.; GangaRao, H.V.S.; Shuck, L.Z.; Chang, H.Y. (West Virginia Univ., Morgantown (USA). Dept. of Mechanical Engineering and Mechanics). Nov 1975. Contract EY-76-C-04-0789;SUB-63-4997-74. 132p. P 07/MF A01.

This report describes analytical and experimental simulations of structural responses associated with hydraulic fracturing operations in rock media. The work presented herein includes: a state-of-the-art literature survey of hydraulic fracturing, rock mechanics and fracture mechanics, results of classical elasticity, crack tip and finite element 2D and 3D stress evaluations; experimental studies; and

applications relating to determination of critical pressures and orientations in terms of crack geometry, material properties, and primitive stresses.

40498 Mechanical and hydraulic properties of rocks related to induced seismicity. Witherspoon, P.A.; Gale, J.E. (Univ. of California, Berkeley). *Eng. Geol. (Amsterdam);* **11**: No. 1, 23-55(Mar 1977).

The mechanical and hydraulic properties of fractured rocks are considered with regard to the role they play in induced seismicity. In many cases, the mechanical properties of fractures determine the stability of a rock mass. The problems of sampling and testing these rock discontinuities and interpreting their non-linear behavior are reviewed. Stick slip has been proposed as the failure mechanism in earthquake events. Because of the complex interactions inherent in the mechanical behavior of fractured rocks, there seems to be no simple way to combine the deformation characteristics of several sets of fractures when there are significant perturbations of existing conditions. Thus, the more important fractures must be treated as individual components in the rock mass. In considering the hydraulic properties, it has been customary to treat a fracture as a parallel-plate conduit and a number of mathematical models of fracture systems have adopted this approach. It is clear from a review of the mechanical and hydraulic properties that not only are fractures easily deformed but they constitute the main flow paths in many rock masses. This means that one must consider the interaction of mechanical and hydraulic effects. When one is attempting to alter the pressure distribution in a fault zone by injection or withdrawal of fluids, the extent to which this can be achieved will be controlled in large measure by the behavior of the fractures that communicate with the borehole. Since this is essentially a point phenomenon, i.e., the changes will propagate from a relatively small region around the borehole, the use of a discrete model would appear to be preferable. In the United States seismicity has been detected as a result of human activities at the Rocky Mountain Arsenal well near Denver and in the Rangely oil field in western Colorado.

PHYSICS RESEARCH

40499 (ORNL/TM—5834) **Status report to the ERDA Nuclear Data Committee.** Perey, F.G.; Gentry, J.C. (comps.). (Oak Ridge National Lab., Tenn. (USA)). Mar 1977. Contract W-7405-ENG-26. 28p. Dep. NTIS $4.00.

This report was prepared for the ERDA Nuclear Data Committee and covers work performed at ORNL since May 1976 in areas of nuclear data of relevance to the U.S. applied nuclear energy program. The report was mostly generated through a review of abstracts of work completed to the point of being subjected to some form of publication in the open literature, formal ORNL reports, ORNL technical memoranda, progress reports, or being presented at technical conferences. As much as possible this report contains merely the complete abstract of the original publication with only minor editing. In a few cases progress reports were written specifically for this publication. The editors selected the materials to be included in this report on the basis of perceived interests of ERDA-NDC members and do not claim completeness.

40500 (UCID—17400) **Activities of the Physical Data Group.** Howerton, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Mar 1977. Contract W-7405-ENG-48. 12p. P 02/MF A01.

A system is described in which neutron interaction data are collected from nuclear physics laboratories throughout the world, organized, evaluated, and then stored for easy access in a computer network. Computer codes that use the data to solve neutron interaction problems were also developed. The system supplies reliable up-to-date data, selects specific types of data on request, provides output in a variety of forms (reports, microfiche, microfilm), and functions rapidly and efficiently. 3 figures.

ASTROPHYSICS AND COSMOLOGY

REFER ALSO TO CITATION(S) 40529, 40538, 40704

COSMIC RADIATION

REFER ALSO TO CITATION(S) 40559

STARS

40501 A model of interacting neutron matter at postsupernova collapse temperatures. Bowers, R.L.; Glesson, A.M.; Wheeler, J.W. (Center for Particle Theory, Physics Department, University of Texas, Austin). *Astrophys. J.;* **213**: No. 2, 531-536(15 Apr 1977).

A model of hot, strongly interacting matter is presented which is relativistic both in its description of the interactions and in its inclusions of finite density and temperature effects. This model, whose zero-temperature limit has been published earlier, is fitted to nuclear matter and has been used to construct model neutron stars whose masses and moments of inertia are in excellent agreement with observational data on pulsars and compact X-ray sources. Extensive numerical results are presented which bridge the temperature and density interval separating current models of supernova remnants as predicted by evolutionary calculations based on ideal-gas equations of state and the final configurations of cold neutron stars. Particular emphasis is given to the region along a collapse adiabat through $T = 10^{10}$ K and $\epsilon = 10^{10}$ g cm^{-3}.

40502 Extreme-ultraviolet observations of flare on Proxima Centauri and implications concerning flare-star scaling theory. Haisch, B.M.; Linsky, J.L.; Lampton, M.; Paresce, F.; Margon, B.; Stern, R. (Joint Institute for Laboratory, Astrophysics, National Bureau of Standards and University of Colorado). *Astrophys. J., Lett.;* **213**: No. 3, L119-L123(1 May 1977).

We report the first detection of EUV radiation from a UV Ceti-type flare star, Proxima Centauri, and derive an emission measure of 4.6 x 10^{52} cm3/sup . ThisimpliesatotalthermalXhyphen/(1-250 A) of L/sub x/=7-18 x 10^{29} ergs s^{-1}. Using past X-ray flare observations of YZ CMi and UV Ceti and a recombination model, we derive limits on L/sub x//L/sub opt/ to test flare-star scaling theories. We conclude that L/sub x//L/sub opt/ in the observed flare is at variance with Mullan's scaling law theory and may be highly variable among stellar flares.

40503 Infrared photometry and mass loss rates for OBA supergiants and Of stars. Barlow, M.J.; Cohen, M. (Joint Institute for Laboratory Astrophysics, University of Colorado). *Astrophys. J.;* **213**: No. 3, 737-755(1 May 1977).

We present infrared observations of 34 OBA supergiants and 10 Of and Oe stars. Excess free-free emission is detectable at 10 μm but not at shorter wavelengths for the supergiants. From our 2.2 and 3.6 μm photometry of the supergiants, in conjunction with existing UBV data, we derive an invariant ratio of total to selective extinction, R=3.10 +- 0.03. Using published radio and infrared data, we derive the velocity law for the mass loss outflow from P Cygni, and we apply this velocity law to the measured 10 μm excess fluxes from our sample of supergiants in order to derive mass loss rates. Our preliminary survey of Of and Oe stars shows excess free-free emission to be common at 3.6 μm and sometimes detectable at 2.2 μm. Using our 2.2—10 μm data, we derive mass loss rates for several O stars. Our results are consistent with radiation pressure being the driving mechanism for mass loss from OBA supergiants and Of stars.

40504 On the possibility of stable quark stars. Bowers, R.L.; Gleeson, A.M.; Pedigo, R.D. (Center for Particle Theory, Physics Department, University of Texas at Austin). *Astrophys. J.;* **213**: No. 3, 840-848(1 May 1977).

A recent zero-temperature equation of state which contains quark-partons separated from conventional baryons by a phase transition is used to investigate the stability of quark stars. The sensitivity to the input physics is also considered. The conclusions, which are found to be relatively model independent, indicate that a separately identifiable class of stable objects called quark stars does not exist.

40505 New mechanism for slowing down the rotation of dense stars. Mikaelian, K.O. (Stanford Linear Accelerator Center, Stanford University). *Astrophys. J., Lett.;* **214**: No. 1, L23-L25(15 May 1977).

Weak neutral currents increase the coupling of neutrinos to stellar matter, yet do not inhibit their escape. We propose that this increased coupling transfers angular momentum to the neutrinos which spiral away, leaving a slower spinning star.

QUASI-STELLAR, RADIO, AND X-RAY SOURCES

40506 (N—76-28121) **Variations in the spectra and pulse period of GX301-2.** Swank, J.H.; Becker, R.H.; Boldt, E.A.; Holt, S.S.; Pravdo, S.H. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jun 1976. Contract NGR-21-002-316. 16p. (NASA-TM-X—71137; X—661-76-117). NTIS $3.50.

Submitted for Publication. Prepared in Cooperation with MD. Univ.

Spectra from observations of GX301-2 (3U1223-62) by the Goddard x-ray spectroscopy experiment on OSO-8 show an absorption edge due to cool iron with column densities of a few x 10^{19}/cm^2. A decrease in intensity was associated with increased absorption and a spectrum similar to those of binary x-ray sources in absorption dips. Observed variations of the pulse period are consistent with Doppler shifts for reasonable orbit parameters. (auth)

40507 Size limits on fluctuating astronomical sources. Terrell, J. (University of California, Los Alamos Scientific Laboratory). *Astrophys. J., Lett.;* **213**: No. 3, L93-L97(1 May 1977).

It is shown that expansion at relativistic speed does not significantly change the limit on luminosity fluctuations of an astronomical source of given maximum effective radius R. The effective pulse length is shown to be T/sub e/approximately-greater-thanR (1+z)/c for an expanding source with redshift z, the same as for a source of constant size. Ths relativistic expansion does not permit larger source sizes for given fluctuations, and does not resolve the conflicts between size limits based on observed fluctuations of quasars and BL Lacertae objects and the minimum surface area needed to radiate sufficient power, if at cosmological distances.These size limits should apply with equal force to other types of fluctuating objects, such as novae, supernovae, and X-ray sources.

SOLAR PHENOMENA

REFER ALSO TO CITATION(S) 40515

40508 (PB—256131) **Seldads: an operational real-time solar—terrestrial environment monitoring system. Technical report.** Williams, D.J. (National Oceanic and Atmospheric Administration, Boulder, Colo. (USA). Space Environment Lab.). Mar 1976. 79p. (NOAA-TR-ERL—357; SEL—37). NTIS $5.00.

This report describes the real-time solar-terrestrial environment monitoring system operated by the Space Environment Laboratory of the National Oceanic and Atmospheric Administration. Information provided includes sources of data, computer systems employed, kinds of data now available and soon to be available, methods of accessing data, and names and addresses of key personnel to contact for access. A description of each type of data available is given which includes satellites or observatories reporting, parameters reported, frequency of report, medium of report, retention period for on-line availability, list of display formats, and sample displays. (GRA)

40509 (N—76-27151) **Results of coronal hole research: an overview.** Wilson, R.M. (National Aeronautics and Space Administration, Huntsville, Ala. (USA). George C. Marshall Space Flight Center). Jul 1976. 38p. (NASA-TM-X—73317). NTIS $4.00.

An overview of the last 10 years of coronal hole research, in particular since 1970, is presented. The findings of the early investigations and the more recent results obtained with Skylab/Apollo Telescope Mount instrumentation are discussed. (auth)

40510 (N—76-28453) **Studies of radiowave propagation in the solar system.** Kolosov, M.A.; Yakovlev, O.I. Aug 1976. Translated from the Book Rasprostraneniye Radiovoin Mowcow, Nauka Press, 1975, p 291-311. (NASA-TT-F—17128). 33p. NTIS $4.00.

A review is given of studies of radiowave propagation in the solar system that were conducted from 1963 to 1973 with the Soviet Spacecraft Venera, Mars, and Luna. Results are presented for satellite radio occultation investigations of the Martian atmosphere. Properties of radiowave propagation in the dense atmosphere of Venus, involving a radio link with descending spacecraft, are examined along with the basic characteristics of the scattering of satellite-emitted radio waves from the lunar surface. Studies of the propagation of monochromatic radiowaves in the solar plasma are reviewed, and investigations carried out in the United States with the Mariner, Pioneer, and Explorer spacecraft are discussed. (auth)

40511 **Whistler heat flux instability in the solar wind with Bi-Lorentzian velocity distribution functions.** Abraham-Shrauner[1], B.; Feldman, W.C. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Geophys. Res.;* **82**: No. 13, 1889-1892(1 May 1977).

The dependence of the growth rate and the threshold level of the whistler heat flux instability in the solar wind at 1 AU on the shape of the velocity distribution function and on the electron halo temperature anisotropy is examined by using a drifted bi-Lorentzian distribution function. We find that for a given set of plasma parameters the maximum growth rate increases sharply with increasing slope of the halo electron velocity distribution and that the whistler instability threshold level increases sharply with increasing halo temperature anisotropy. In view of the sensitivity of the whistler instability threshold level to details of the shape of halo electron distribution functions it is not now possible to decide unambiguously if the whistler mode regulates the interplanetary heat flux some of the time at 1 AU, but it remains a strong candidate.

COSMOLOGY

40512 **Particle generation and vacuum polarization in an anisotropic universe.** Vereshkov, G.M.; Grishkan, Y.S.; Ivanov, S.V.; Nesterenko, V.A.; Poltavtsev, A.N. (Rostov State University). *Sov. Phys. - Dokl. (Engl. Transl.);* **21**: No. 11, 656-657(Nov 1976).

Field equations are solved for the vacuum states in an anisotropic universe. The renormalization of energy-momentum tensor is also discussed.(AIP)

PLANETARY PHENOMENA

REFER ALSO TO CITATION(S) 40510

40513 (N—76-28136) **First pictures of the surface of Venus (preliminary analysis).** Vinogradov, A.P.; Florenskii, K.P.; Bazilevskiy, A.T.; Selivanov, A.S. Translated from *Pis'ma Astron. Zh.;* **2**: No. 2, 67-71(Feb 1976). 10p. (NASA-TT-F—15487). NTIS $3.50.

Venera-9 and Venera-10 pictures of the surface of Venus were obtained by panoramic phototelevision cameras (scanning telephotometers) with an angular resolution of 1/3 deg from a viewing point about 1 m above the surface. The panoramic axis of the telecamera is slanted downward and forms an angle of approximately 40 deg with the vertical axis. The total panoramic field is about 40 x 180 deg. The pictures and illumination conditions are described, taking into account the imaging system characteristics. Particular geological and morphological features are analyzed and discussed. The rock at the landing sites can, in terms of its radioactivity (corresponding to terrestrial basalts), density (determined by a gamma densitometer), and overall appearance, be classified as basaltoid. The nature of the stony surface detected at two random sites on Venus also agrees with the average density value ($2.3 +- 0.4$ g/cm^3) obtained by radar measurements. Therefore, it can be considered typical of the Venus surface. (auth)

40514 (N—76-28139) **Surface chemistry of selected lunar regions.** Bielefeld, M.J.; Reedy, R.C.; Metzger, A.E.; Trombka, J.I.; Arnold, J.R. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jun 1976. 32p. (NASA-TM-X—71157; X—682-76-149). NTIS $4.00.

A completely new analysis has been carried out on the data from the Apollo 15 and 16 gamma ray spectrometer experiments. The components of the continuum background have been estimated. The elements Th, K, Fe and Mg give useful results; results for Ti are significant only for a few high Ti regions. Errors are given, and the results are checked by other methods. Concentrations are reported for about sixty lunar regions; the ground track has been subdivided in various ways. The borders of the maria seem well-defined chemically, while the distribution of KREEP is broad. This wide distribution requires emplacement of KREEP before the era of mare formation. Its high concentration in western mare soils seems to require major vertical mixing. (auth)

ATMOSPHERIC PHYSICS

AURORAL AND IONOSPHERIC PHENOMENA

REFER ALSO TO CITATION(S) 40508

40515 (N—76-29146) **Ionization effects due to solar flare on terrestrial ionosphere. Final technical report.** Wu, S.T.; Tan, A. (Alabama Univ., Huntsville (USA)). Jul 1976. Contract NGR-01-008-015. 32p. (NASA-CR—148476; UAH-RR—188). NTIS $4.00.

Sudden frequency deviation ionospheric disturbances related to the flares of May 18 and 19, 1973, were observed from the NASA/MSFC high-frequency Doppler sounder array system in Huntsville, Alabama. The results are compared with those observed at Table Mountain near Boulder, Colorado, and at the University of Hawaii. (auth)

MAGNETOSPHERIC PHENOMENA

40516 (AD-A—030331) **Hydromagnetic waves: temporal development of coupled modes. Environmental research papers.** Radoski, H.R. (Air Force Geophysics Lab., Hanscom AFB, Mass. (USA)). 6 May 1976. 38p. (AFGL-TR—76-0104; AFGL-ERP—559). NTIS $4.00.

Numerical solutions to the initial value problem have been obtained for the guided (toroidal) and isotropic (poloidal) electric fields of hydromagnetic waves for the asymmetric case. The cylindrical model of the inner magnetosphere has been used in which the field lines are arcs of circles and the surface of the earth is planar. The cases considered have the initial disturbance completely restricted to either the guided or isotropic field components to emphasize the effect of coupling. The development of the system has been calculated for asymmetric modes of order m = 1 to 10, corresponding to from one to ten full waves in longitude, and the lowest order (n = 1) field-line mode, corresponding to a half-wave along a field line. The initial isotropic (east—west) electric-field component is in an eigenstate of the symmetric or uncoupled poloidal mode. In this case, when the coupling is reduced to zero, the isotropic electric field simply oscillates harmonically. The initial guided (north—south) electric-field component is defined to increase radially and towards higher latitudes. As a check on the numerical solutions, the total energy of the system is continually calculated and compared with the initial energy. Although no damping is included in the

problem, the poloidal-mode energy decays with time, as has been shown theoretically. The toroidal mode reaches maximum amplitude in regions of relatively narrow latitudinal extent. The large spatial variation of the magnetic field in these resonance regions must be associated with large field aligned currents. (auth)

40517 On the high correlation between long-term averages of solar wind speed and geomagnetic activity. Crooker, N.U.; Feynman, J.; Gosling, J.T. (Department of Atmospheric Sciences, University of California at Los Angeles, Los Angeles, California 90024). *J. Geophys. Res.;* **82**: No. 13, 1933-1937(1 May 1977).

Six-month and yearly averages of solar wind speed from 1962 to 1975 are shown to be highly correlated with geomagnetic activity as measured by averages of the AP index. On the same time scale the correlation between the southward component of the interplanetary magnetic field and geomagnetic activity is poor. Previous studies with hourly averages give opposite results. The better correlation with the southward component on an hourly time scale is explained by its large variation compared to the relatively constant solar wind speed. However, on a yearly time scale the magnitude of the variations in both parameters are about the same. This problem can be solved by invoking an energy transfer mechanism which is proportional to the first power of the southward component and a higher power of the solar wind speed.

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

40518 Ab initio configuration interaction studies of the electronic states of S_2N_2 . Jafri, J.A.; Newton, M.D.; Pakkanen, T.A.; Whitten, J.L. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *J. Chem. Phys.;* **66**: No. 11, 5167-5172(1 Jun 1977).

Ab initio SCF and CI calculations are reported for the sulfur nitride, SN, and disulfur dinitride, S_2N_2, molecules. Calculations on SN, varying the internuclear distance, are performed using a variety of basis sets to determine a suitable basis for S_2N_2. The total energy, internuclear distance, and force constant of SN are reported for several choices of basis. Extended basis computations on S_2N_2 are performed, and midbond polarization functions are found to contribute significantly to a description of the ground state, affecting the higher MO's and the charge density. A prominent feature of the virtual spectrum is the existence of a low energy π^* orbital which could play a role in low lying excited states, the polymerization process, and polymer conductivity. CI studies of the ground and excited states of S_2N_2 show several low lying singlet and triplet states of the type πyieldsσ^*, πyieldsπ^*, and σyieldsπ^*, and possible identifications with experiment are discussed. A possibility of relating the observed paramagnetism on polymerization to (SN)/sub x/ to properties of the monomer S_2N_2 was considered, but the calculations do not support this hypothesis for the monomer in its square equilibrium geometry since no excited states were found to be accessible by thermal excitation.

40519 Optically detected magnetic resonance spectra of the lowest triplet states of benzophenone, ^{13}C-benzophenone, and three 4,4'-dihalobenzophenones. Mucha, J.A.; Pratt, D.W. (Department of Chemistry, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). *J. Chem. Phys.;* **66**: No. 12, 5339-5355(15 Jun 1977).

We describe measurements of the complete angular dependence of the optically detected magnetic resonance (ODMR) spectra of the lowest triplet states of benzophenone, carbonyl-^{13}C-benzophenone, 4,4'-difluorobenzophenone, 4,4'-dichlorobenzophenone, and 4,4'-dibromobenzophenone in 4,4'-dibromodiphenylether host crystals at liquid helium temperatures. The principal axes and values of D (including the absolute signs) and g are reported and used to evaluate the spin—spin and spin—orbit contributions to the fine-structure tensor of the parent molecule. It is found that the dipolar contributions to D in $^3(n,\pi^*)$ benzophenone are at least a factor of 2 less than recent ab initio estimates of the spin—spin contributions to D in $^3A_2$ formaldehyde. Carbon-13 hyperdfine splittings have been observed in the ODMR spectra of ^{13}C-benzophenone; an analysis of these yields estimates of the orbital spin densities rho$_2$/sub s//sup() CO/0.008 and rho$_2$/sub p/x-italic/sup() CO/< or =0.14 and suggests that the C_1—C(O) —C_1' fragment is planar. The fine-structure parameters of triplet benzophenone are strongly influenced by halogen atoms in the para ring positions. The ODMR spectra of the 4,4'-difluoro and 4,4'-dibromo derivatives also exhibit ring halogen atom hyperfine structure from which the estimate rho$_2$/sub p/π/sup C/ 4< or =0.10 is obtained. Taken together, the results of this investigation suggest that as much as 50% of the total spin density in the lowest triplet state of benzophenone itself resides on the aromatic rings, thereby accounting for the reduction in the dipolar contributions to D in the parent molecule and for the changes in the principal values (and directions) of D which occur in its heavy-atom substituted derivatives.

40520 Level-anticrossing and cross-relaxation effects in oriented molecular triplet states. $^3(n,\pi^*)$ benzophenones in 4,4'-dibromodiphenylether. Mucha, J.A.; Pratt, D.W. (Department of Chemistry, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). *J. Chem. Phys.;* **66**: No. 12, 5356-5367(15 Jun 1977).

This paper reports the observation and analysis of magnetically induced changes in the phosphorescence intensities of triplet state benzophenone, carbonyl-^{13}C-benzophenone, and three 4,4'-dihalobenzophenones in single crystals of 4,4'-dibromodiphenylether at 1.6degreeK. The signs, magnitudes, field positions, and widths of these changes can be interpreted in terms of two effects, anticrossings of two different electron—nuclear spin manifolds of the guest molecule and cross relaxation between the spin system of the guest and that of the host. At fields where anticrossings occur, the mixing between the spin states is strong and no hyperfine structure is observed. However, by comparing the results for the different molecules in the same host, it is shown that secular terms of the hyperfine interaction play a key role in determining the minimum spectral widths of the "transitions". At fields where cross relaxation predominates, the mixing between the spin states is weak and hyperfine and quadrupole splittings of both the guest and host can be resolved. The magnetic and optical parameters obtained by fitting the "spectra" are in excellent agreement with those determined by ODMR techniques [J. A. Mucha and D. W. Pratt J. Chem. Phys. 66, 5339 (1977), preceding paper]. Thus, experiments of this type can be utilized to provide information about the fine-structure, g, hyperfine, and quadrupole tensors of emitting paramagnetic species in the complete absence of perturbing radiofrequency or microwave fields. Moreover, the systems described herein offer considerable promise in future studies of spin relaxation mechanisms in molecular solids by optical detection methods.

BEAMS AND THEIR REACTIONS

REFER ALSO TO CITATION(S) 39887

40521 Photoionization studies of the diatomic heteronuclear rare gas molecules XeKr, XeAr, and KrAr. Ng, C.Y.; Tiedemann, P.W.; Mahan, B.H.; Lee, Y.T. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). *J. Chem. Phys.;* **66**: No. 12, 5737-5743(15 Jun 1977).

The photoionization efficiency curves of the heteronuclear rare gas van der Waals molecules XeKr, XeAr, and KrAr were obtained with the molecular beam technique in the wavelength range from 790 to 1065 A (11.64—15.69 eV). The ionization potentials were found to be 11.757 +- 0.017 eV for XeKr, 11.985 +- 0.017 eV for XeAr, and 13.425 +- 0.020 eV for KrAr. From the known dissociation energies of the ground state XeKr, XeAr, and KrAr van der Waals molecules as determined by low energy molecular beam elastic scattering experiments, the binding energies for the ground state of the heteronuclear rare gas molecular ions were deduced to be 0.37 +- 0.02 eV for $XeKr^+$, 0.14 +- 0.02 eV for $XeAr^+$, and 0.59 +- 0.02 eV for $KrAr^+$. The photoion spectra of the heteronuclear rare gas dimers R_1R_2 exhibit prominent autoionization structure, which is found to correlate very well with the excited molecular Rydberg states $R_1^*R_2$ and $R_1R_2^*$ formed by the interaction of a normal ground state rare gas atom R_1 (or R_2) and an excited atom R_2^* (or R_1^*), in the $n'p^5(^2P_{1/2}$/sub ,/$_{3/2})$ ns (nd) configuration (where n'=3 for Ar, n'=4 for Kr, and n'=5 for Xe). The excitation of XeKr, XeAr, and KrAr is found to obey the parity selection rule $\Delta l = +- 1$, in agreement with previous experimental observations in the photoionization studies of Kr_2 and Ar_2. The Rydberg series $5p^5(^2P_{1/2})$ ns (nd) for Xe, and $4p^5(^2P_{1/2})$ ns (nd) for Kr, were red shifted with respect to the positions in the photoionization efficiency curves of Xe and Kr. This allows one to calculate the potential energy for the excited molecular Rydberg state at a distance which corresponds to the equilibrium interatomic distance of the ground state van der Waals molecule. For $Xe[5p^5(^2P_{1/2})$ ns (nd)]+$Ar(^1S_0)$ one obtains 0.06 eV and for $Xe(^1S_0)+Kr[4p^5(^2P_{1/2})$ ns (nd)] 0.10 eV.

ATOMIC AND MOLECULAR PROPERTIES

REFER ALSO TO CITATION(S) 40527, 40538, 40604

40522 Evidence for shakeup satellites due to surface contamination in arsenic metal and its compounds. Bahl, M.K.; Watson, R.L. (Texas A and M Univ., College Station). *Surf. Sci.;* **54**: No. 3, 540-546(Mar 1976).

Satellites accompanying the main peaks were observed in the x-ray photoelectron spectra of arsenic metal and its compounds. These satellites are examined in terms of various mechanisms such as multi-electron excitation energy losses. In addition to plasmon satellites, a satellite doublet associated with the 3d peak is attributed to charge-transfer shakeup from the 2psigma level of carbon (present as a surface contamination) to the Fermi level of arsenic. Such charge-

transfer shake-up satellites may be caused by a difference in the relaxation energy of surface arsenic atoms as compared to bulk arsenic atoms resulting from the presence of weakly bonded carbon. 4 figures, 1 table.

40523 Experimental studies of mercury molecules. Drullinger, R.E.; Hessel, M.M.; Smith, E.W. (Laser Physics Section, National Bureau of Standards, Boulder, Colorado 80302). *J. Chem. Phys.;* **66**: No. 12, 5656-5666(15 Jun 1977).

Optically excited fluorescence spectra in pure mercury vapor have been studied over the spectral range 240—600 nm for temperatures between 400—1000 K and densities between 5×10^{16}—2×10^{19} cm^{-3}. Absorption measurements were made over the spectral range 253—334 nm, and both structured and continuum bands were observed. Several types of two photon experiments were also performed in order to probe the excited states of the mercury dimer. In addition, the mercury spectrum from mercury vapor—noble gas mixtures has also been studied for noble gas pressures up to 1 atm.

40524 Excimer densities and destruction mechanisms in a high pressure pure mercury positive column. Mosburg, E.R. Jr.; Wilke, M.D. (Laser Physics Section, National Bureau of Standards, Boulder, Colorado 80302). *J. Chem. Phys.;* **66**: No. 12, 5682-5693(15 Jun 1977).

A study of a pure mercury vapor dc discharge at gas densities of 0.75×10^{18} to 10^{19} cm^{-3} and currents of 30—100 mA has allowed us to determine the densities of the atomic 6 $^3P_0$/sub ,/$_1$/sub ,/$_2$/sub ,/ and 7 $^3S_1$ levels and the dimer ^{3}1/sub u/ level as well as the density of free electrons. We find the density of the ^{3}1/sub u/ level (which radiates the 335 nm band) to be several orders of magnitude below that needed for lasing on this transition. An analysis of the measured spacial profiles leads us to conclude that mercury trimers figure prominently into the kinetics of the system and that the destruction of these trimers is primarily by electron collisions. We also report evidence that the three-body rate for production of trimers from dimers greatly exceeds that for the formation of dimers from excited atoms. The procedures for analysis of the spacial profiles developed here constitute a new method for the semiquantitative determination of rate coefficients not otherwise accessible to measurement.

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 39972, 40537

40525 (CONF-761059—19) **K-shell x-ray production cross sections of selected elements Al to Ni for 4.0 to 38.0 MeV ^{10}B ions.** Monigold, G.; McDaniel, F.D.; Duggan, J.L.; Mehta, R.; Rice, R.; Miller, P.D. (North Texas State Univ., Denton (USA)). 1976. Contract W-7405-ENG-26. 5p. Dep. NTIS $3.50.

From 4. annual conference on the use of small accelerators; Denton, Texas, United States of America (USA) (25 Oct 1976).

K-Shell x-ray production cross sections for the target elements Sc, Ti, V, Mn, Fe, Co, and Ni were measured for incident ^{10}B ions over the energy range 4.0 to 38.0 MeV. The cross section data were compared to the theoretical predictions of the binary encounter approximation (BEA); the plane wave born approximation (PWBA); and the PWBA modified to include corrections for increased binding energy (B), Coulomb deflection of the incident ion (C), orbital perturbation due to polarization (P), and relativistic effects (R). In addition, fluorescence yield variations (W/sub K/) and contributions to the cross sections from electron capture (EC) were included. It was found that the predictions of the fully modified PWBA with contributions from electron capture and fluorescence yield variations included provided the best fit to the experimental data over the entire energy range for each target element. The $K\beta/K\alpha$ x-ray intensity ratios were compared to theoretical values that assume single hole ionization, and the x-ray energy shifts presented as a function of the energy of the incident ion. These two measurements provided confirmation of the occurrence of multiple ionization for ^{10}B bombardment of target elements in the range 21 less than or equal to Z_2 less than or equal to 28.

40526 (COO—3570-19) **Research in high-energy chemical reactions. Final report.** Cross, R.J. Jr. (Yale Univ., New Haven, Conn. (USA). Dept. of Chemistry). Mar 1977. Contract EY-76-S-02-3570. 5p. P 02/MF A01.

A study of the energy dependence of the cross section (rate constant) of reactions of hot tritium atoms is briefly recounted. A typical reaction is c-C_6D_{12} + T* yields c-$C_6D_{11}T$ + D, C_6D_{11} + DT. Difficulties encountered in the program are discussed. No data are given. It was found that the idea that recoil tritium ions in a helium moderator could escape being neutralized and react as ions was false. (RWR)

40527 Electron and photon interactions with atoms. Kleinpoppen, H.; McDowell, M.R.C. (eds.). New York; Plenum Press (1976). 700p. (CONF-740778—).

From International symposium on electron and photon interactions with atoms; Stirling, United Kingdom of Great Britain and Northern Ireland (UK) (16 Jul 1974).

Separate abstracts were prepared for the 57 papers presented. (JFP)

40528 Effects of configuration interaction on electron and photon interactions with atoms. Burke, P.G. (Queen's Univ., Belfast). pp 1-25 of In Electron and photon interactions with atoms. Kleinpoppen, H.; McDowell, M.R.C. (eds.). New York; Plenum Press (1976).

From International symposium on electron and photon interactions with atoms; Stirling, United Kingdom of Great Britain and Northern Ireland (UK) (16 Jul 1974).

See CONF-740778—.

A review is presented of the effects of configuration interaction on photoionization of atoms and electron-atom scattering. The emphasis is on experimental and theoretical studies carried out since the basic paper by Fano (1961) on this subject.

40529 Low energy electron scattering and attachment by C, N, and O. Nesbet, R.K.; Thomas, L.D. (IBM Research Lab., San Jose, CA). pp 27-34 of In Electron and photon interactions with atoms. Kleinpoppen, H.; McDowell, M.R.C. (eds.). New York; Plenum Press (1976).

From International symposium on electron and photon interactions with atoms; Stirling, United Kingdom of Great Britain and Northern Ireland (UK) (16 Jul 1974).

See CONF-740778—.

Recent theoretical calculations provide a consistent description of low energy electron scattering by C, N, and O atoms and of the corresponding negative ion states. This work is summarized and reviewed. New results are reported of e-O scattering calculations by the matrix variational method. These calculations include near-degenerate correlation and virtual excitation effects, which must be taken into account in order to locate resonances and negative ions states correctly in energy. They also include the principal residual effect of target atom polarizability, which produces a large reduction in the low-energy electron scattering cross section, consistent with earlier polarized orbital calculations.

40530 Crossed molecular beam study of electronic energy transfer: Hg(6^{3}P$_2$) + NO(X^{2}II) yields NO(A$^2\Sigma$) + Hg(6^{1}S/sub 0). Krause, H.F.; Datz, S. (Oak Ridge National Lab., TN). *Chem. Phys. Lett.;* **41**: No. 2, 339-343(15 Jul 1976).

Near resonant electronic energy transfer in the reaction Hg(6 $^3P_2$) + NO(X ^{2}II) yields NO(A $^2\Sigma$) + Hg(6 $^1S_0$) has been investigated in a thermal energy crossed beam experiment. The most probable rotational state in the product, NO(A $^2\Sigma$), exceeds that of the reactant, NO(X ^{2}II), by approximately 3 rotational levels for molecular beam temperature in the range 100-400°K. The rate constant for this reaction is $(1.07 \pm 0.1) \times 10^{-11}$ cm^3/s molecule for an NO(X ^{2}II) beam at 300°K.

40531 Endothermic reactions of uranium ions with N_2, D_2, and CD_4. Armentrout, P.B.; Hodges, R.V.; Beauchamp, J.L. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125). *J. Chem. Phys.;* **66**: No. 10, 4683-4688(15 May 1977).

An ion beam apparatus is employed to study the reactions of uranium ions with N_2, D_2, and CD_4 at laboratory energies up to 335 eV. The endothermic reaction of U^+ with nitrogen leads to the product UN^+ for which a bond dissociation energy $D(UN^+) = 4.7 \pm 0.2$ eV is determined, corresponding to $\Delta H/sub\ f/(UN^+) = 272 \pm 7$ kcal/mole. Endothermic reactions of U^+ with D_2 and CD_4 lead to formation of UD^+ with $D(UD^+) = 2.9 \pm 0.1$ eV and $\Delta H/sub\ f/(UD^+) = 254 \pm 6$ kcal/mole. The dependence of experimental reaction cross sections on relative kinetic energy is discussed in terms of simple models for reaction. The proton affinity of uranium is determined, P.A.(U) = 238 +- 5 kcal/mole, and this exceptionally high value is compared to other atomic and molecular base strengths.

40532 Pressure-broadened linewidths of formaldehyde. Tejwani, G.D.T.; Yeung, E.S. (Ames Laboratory-ERDA and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *J. Chem. Phys.;* **66**: No. 11, 4915-4918(1 Jun 1977).

Self-broadened and foreign-gas (N_2 and O_2) -broadened linewidths of H_2CO at 300degreeK for a wide range of quantum numbers J and K/sub a/, for all three types of bands, have been calculated using the Anderson—Tsao—Curnutte theory of line broadening. Due to the large dipole moment of formaldehyde, quadrupolar interactions were found to contribute negligibly to the linewidth. Because of this, in the case of H_2CO—H_2CO collisions, only dipole—dipole interaction has been included. For H_2CO—N_2 and H_2CO—O_2 collisions, dipole—quadrupole interaction was taken into account. Computed values for self- and N_2-broadened linewidths are in good agreement with the measured values reported in the literature. Air-broadened linewidths of H_2CO have also been calculated at 200degreeK so that the temperature dependence can be estimated.

40533 Energy and angular distributions of electrons ejected from water vapor by 0.3—1.5 MeV protons. Toburen, L.H.; Wilson, W.E. (Battelle Northwest Laboratories, Richland, Washington 99352). *J. Chem. Phys.;* **66**: No. 11, 5202-5213(1 Jun 1977).

Absolute cross sections, differential in electron energy and ejection angle, have been measured for ejection of electrons from water vapor by protons with energies from 0.3 to 1.5 MeV. These cross sections are compared with similar measurements for ionization of molecular hydrogen and oxygen and previously published results for hydrocarbon. The criteria for additivity and scalability of electron ejection cross sections are discussed.

40534 Orthogonality constraints in electron scattering by open-shell targets: Comments on a paper by Riley and Truhlar . Rescigno, T.N. (Theoretical Atomic and Molecular Physics, Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *J. Chem. Phys.;* **66**: No. 11, 5255-5257(1 Jun 1977).

S-wave e^--H scattering in the static-exchange approximation as considered by Riley and Truhlar is commented upon. The orthogonality constraints are discussed.(AIP)

40535 Further comment on sudden approximations in rotationally inelastic scattering . Pack, R.T. (Theoretical Division, University of California Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **66**: No. 11, 5257-5258(1 Jun 1977).

The quantum-mechanical infinite order sudden (IOS) approximation is further discussed in relation to rotationally inelastic scattering in molecular collisions.(AIP)

40536 Velocity distribution of H(2s) resulting from the electron impact dissociation of H_2 . Hazi, A.U.; Wiemers, K. (University of California, Lawrence Livermore Laboratory, P. O. Box 808, Livermore, California 94550). *J. Chem. Phys.;* **66**: No. 12, 5296-5305(15 Jun 1977).

We have calculated the velocity distribution of the fast, metastable hydrogen and deuterium atoms which result from the dissociation of the $^1\Pi_u/(2p\pi_u/, 2s\sigma_g/)$ autoionizing states of H_2 and D_2. The present model uses the previously computed potential energy curve and autoionization width of this doubly excited $^1\Pi_u$ state. The model treats the competition between ionization and dissociation into neutral fragments classically. In calculating the laboratory velocity distribution we take into account the thermal motion of the target molecules and the recoil due to the scattered electron. The effect of momentum transfer is important, as the calculated laboratory speed distribution depends sensitively on the angle of detection. The comparison of the experimental and the theoretical velocity distributions shows a significant discrepancy among the three measurements which have been reported to date.

ATOMIC AND MOLECULAR THEORY

REFER ALSO TO CITATION(S) 40521, 40528

40537 Ejection of electrons from autoionizing states in atoms. Bottcher, C. (Univ. of Manchester, Eng.). pp 35-38 of In Electron and photon interactions with atoms. Kleinpoppen, H.; McDowell, M.R.C. (eds.). New York; Plenum Press (1976).

From International symposium on electron and photon interactions with atoms; Stirling, United Kingdom of Great Britain and Northern Ireland (UK) (16 Jul 1974).

See CONF-740778—.

Experimentalists are increasingly interested in the information that can be obtained from the angular and energy distributions of electrons ejected from autoionizing states. One considers two problems in this area: the relation of the angular distributions to the symmetry of the autoionizing state; the effect of interactions between the ejected and scattered electrons when the autoionizing state is excited by low energy electrons.

40538 Study of photoionization processes using synchrotron radiation. Marr, G.V. (Univ. of Berkshire, Eng.). pp 39-67 of In Electron and photon interactions with atoms. Kleinpoppen, H.; McDowell, M.R.C. (eds.). New York; Plenum Press (1976).

From International symposium on electron and photon interactions with atoms; Stirling, United Kingdom of Great Britain and Northern Ireland (UK) (16 Jul 1974).

See CONF-740778—.

The characteristics of synchroton radiation as a UV and x-ray source of photons are reviewed, monochromator design problems are stated, and experimental rigs in use at the Daresbury Synchrotron Radiation Facility are discussed. The requirements for a systematic study of atomic photoionization processes are outlined through energy level analysis, cross section measurements, and angular distribution studies of photoelectrons. Progress made is reviewed and new data presented for total cross section measurements on argon and krypton and the partial cross section for 3s electrons ejected from argon. Angular distribution studies of the asymmetry parameter are discussed and inert gas data compared with theory which provides evidence of multielectron correlation effects. An analysis of spin-orbit interaction effects on the angular distribution of s electrons from alkali metal vapors is reported.

40539 Electron affinities of polar molecules. Crawford, O.H.; Garrett, W.R. (Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Chem. Phys.;* **66**: No. 11, 4968-4970(1 Jun 1977).

All molecules having dipole moments greater than 1.625 D (0.639 ea_0) have positive electron affinities in the Born—Oppenheimer approximation (i.e., when the nuclei are stationary). However, when nuclear motion is treated exactly, the above sufficient condition for binding an extra electron is modified. We have determined the magnitudes of Born—Oppenheimer electron affinities which are required in order to insure that the negative ions of polar molecules ($\mu < 1.625$ D) are still stable when the nuclei are free to move.

40540 A theoretical analysis of mercury molecules. Smith, E.W.; Drullinger, R.E.; Hessel, M.M.; Cooper, J. (Laser Physics Section, National Bureau of Standards, Boulder, Colorado 80302). *J. Chem. Phys.;* **66**: No. 12, 5667-5681(15 Jun 1977).

A theoretical analysis of experimental observations on bound—free electronic transitions in mercury molecules is presented. Potential curves and A values are derived for these transitions and the possibility of emission from a mercury trimer is also discussed briefly. These data are then used to produce a simple model for an optically pumped 335 nm mercury laser. A table is given which predicts the small signal gain at 335 nm as a function of temperature, density, and the excimer density in the vapor.

GENERAL FLUID DYNAMICS

REFER ALSO TO CITATION(S) 40625, 40716

40541 Prediction of turbulent forced plumes issuing vertically into stratified or uniform ambients. Madni, I.K.; Pletcher, R.H. (Asst. Mechanical Engineer, Department of Applied Science, Brookhaven National Laboratory, Upton, N.Y. Assoc. Mem. ASME). *J. Heat Transfer;* **99**: No. 1, 99-104(Feb 1977).

A finite difference calculation method is used to solve the conservation equations of mass, momentum, and energy in differential form for a buoyant turbulent forced plume discharging vertically into both a uniform and a stratified quiescent ambient. This flow configuration is of interest relative to the discharge of thermal or sewage effluents into the ocean and the discharge of effluents from chimneys and cooling towers into a still atmosphere. The effects bouyancy on the turbulent transport model are discussed. The predictions, including the prdicted maximum height of rise for the stratified ambient case, are compared with available experimental data and the results of other prediction methods.

40542 Kinetic theory analysis of rarefied gas flow through finite length slots. Raghuraman, P.; Willis, D.R. (Department of Mechanical Engineering, University of California, Berkeley, California 94720). *Phys. Fluids;* **20**: No. 6, 895-902(Jun 1977).

A kinetic theory analysis is made of the flow of a rarefied monatomic gas through a two-dimensional slot connecting two reservoirs. Numerical solutions are obtained by the moment and discrete ordinate methods. The former method portrays the transition regime characteristics well, but has limitations in the free molecule regime. The latter method gives accurate results in the free molecule and slip regime and bolsters confidence in the accuracy of the transition regime results. The numerical solution for the mass flux through the slot agrees well with an approximate analytic solution of the moment equations for length-to-width ratios from 6 to 0.5, pressure ratios from 0.8 to 0.1, and Knudsen numbers from 5 to 0.5.

MAGNETOHYDRODYNAMICS

40543 Stationary convective-like modes in a plasma slab with magnetic shear. Dagazian, R.Y.; Paris, R.B. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Fluids;* **20**: No. 6, 917-927(Jun 1977).

The combined effects of resistivity and viscosity on a magnetohydrodynamically unstable plasma slab are shown to be responsible for the existence of a stationary (marginal) mode. This mode gives rise to plasma convection in a shear-free situation when nonlinear effects are taken into account. In the case of a sheared magnetic field, it still extends over the entire width of the slab and is driven by what would be an interchange localized about the resonant ($k_x B/\sup(/^0)=0$) surface in the absence of dissipation. The critical value of the plasma analog of the Rayleigh number in hydrodynamics is calculated as a function of shear, mode wavenumber, and dissipation (represented by the square of the Hartmann number).

SUPERFLUIDITY

40544 Measurement of the difference between the dynamic NMR and static susceptibilities of superfluid ^{3}He-B using an rf-biased superconducting quantum-interference device. Webb, R.A. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.;* **38**: No. 20, 1151-1155(16 May 1977).

The temperature-dependent susceptibility of superfluid ^{3}He-B has been measured both statically and via a pulse technique in a field of 309 G using an rf-biased superconducting quantum-interference device (SQUID). In the pressure range 26.5 to 18 bar, the dynamic NMR susceptibility agrees qualitatively with the theoretical weak-coupling predictions for the Balian-Werthamer state. However, the static susceptibility, measured using the same rf-biased SQUID and detection system, is significantly smaller than the dynamic susceptibility.

HIGH ENERGY PHYSICS

40545 (BNL—50579) Proceedings of the Summer Study Meeting on Kaon Physics and Facilities. Palevsky, H. (ed.). (Brookhaven National Lab., Upton, N.Y. (USA)). Dec 1976. Contract EY-76-C-02-0016. 445p. (CONF-760644—). Dep. NTIS $11.75.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

The proceedings of a Summer Study Meeting on "Kaon Physics and Facilities" held at Brookhaven National Laboratory on June 1-5, 1976 are presented. The purpose of the meeting was twofold: (a) to investigate methods for increasing kaon fluxes for experimental use by one or two orders of magnitude above current values and (b) to evaluate the impact this might have on the development of kaon physics. A separate abstract for each of the twenty-one papers was prepared for ERDA Energy Research Abstracts (ERA) and for the INIS Atomindex.

40546 (UCD—34P191-9) U.C. Davis high energy particle physics research. Annual progress report, December 16, 1975—December 31, 1976. Gunion, J.F.; Klems, J.; Ko, W.; Lander, R.L.; Pellett, D.E.; Yager, P.M. (California Univ., Davis (USA). Dept. of Physics). Jan 1977. Contract EY-76-S-03-0034. 10p. Dep. NTIS $3.50.

Progress in experimental and theoretical research efforts in high energy physics at U. C. Davis is reported. (SDF)

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

ELECTROMAGNETIC INTERACTIONS

40547 (LBL—5305) Determination of the axial-vector form factor in the radiative decay of the pion. Ortendahl, D.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1976. Contract W-7405-ENG-48. 122p. Dep. NTIS $5.50.

Thesis.

The branching ratio for the decay π yields $e\nu\gamma$ was measured in a counter experiment in which the e^+ was detected in a magnetic spectrometer and the γ-ray in a lead glass hodoscope. The number of observed events is 226.2 +- 22.4. The branching ratio into the phase space with electron momentum above 56 MeV/c and the electron/photon opening angle greater than 132° is found to be (5.5 +- 0.7) x 10^{-8}. From the measured branching ratio one determines γ, the ratio of the axial vector to vector form factor. The vector form factor is computed using CVC and the π^0 lifetime. For T/sub π^0 = 0.828 x 10^{-16} sec, γ = 0.44 +- 0.12 or γ = —2.36 +- 0.12 is obtained. A comparison between the measured values of γ and various theories is made.

40548 Multipole analysis of the reactions γpyieldsnπ^+, γpyieldspπ^0, and γpyieldspπ^- in the vicinity of the first pion—nucleon resonance. Ganenko, V.B.; Gorbenko, V.G.; Krivets, A.G.; Kolesnikov, L.Y.; Miroshnichenko, I.I.; Nikiforov, V.I.; Sanin, V.M.; Sorokin, P.V.; Shalatskii, S.V. (Physico-technical Institute, Ukrainian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 594-599(Dec 1976).

An energy-independent multipole analysis of single-pion photoproduction is carried out in the γ quantum range from 250 to 500 MeV. The calculated values of the P_{33} resonance phase shift in photoproduction are in good agreement with the corresponding values of the πN scattering phase shift δ_{33}.

40549 From the psi to charm: The experiments of 1975 and 1976. Richter, B. (Stanford Linear Accelerator Center, Stanford University Stanford, California 94305). *Rev. Mod. Phys.;* **49**: No. 2, 251-266(Apr 1977).

The discovery of the psi particle at SPEAR is reviewed. The properties of psi are discussed as are the implications of the discovery to the quark model.

WEAK INTERACTIONS

40550 (BNL—50579, pp 169-187) Survey of hyperon beta decay. Smith, A.J.S. (Princeton Univ., NJ). Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

Highlights of present knowledge of beta decays of hyperons are summarized with indication given of significant improvements likely to occur in the near future. The processes B_1 yields B_2lν/sub l/, where B_1 and B_2 are the initial and final baryons, respectively, l is either μ or e, and ν/sub l/ the neutrino are treated. 16 references. (JFP)

40551 Production and detection of intermediate vector bosons and heavy leptons in pp and p-anti p collisions. Quigg, C. (Fermi National Accelerator Laboratory, P. O. Box 500, Batavia, Illinois 60510). *Rev. Mod. Phys.;* **49**: No. 2, 297-315(Apr 1977).

Prospect for the discovery of the charged and neutral intermediate vector bosons in high-energy nucleon— (anti)nucleon collisions are examined. Theoretical arguments for the existence of intermediate bosons are reviewed and the anticipated properties are enumerated. Detailed calculations based on the Drell—Yan model are presented for the production cross sections and for the distributions of decay products. On the basis of these computations the requirements for experimental detectors are assessed.

40552 Observation of a new process with trimuon production by high-energy neutrinos. Benvenuti, A.; Cline, D.; Cooper, P.; Heagy, M.; Imlay, R.; Johnson, M.E.; Ling, T.Y.; Lundy, R.; Mann, A.K.; McIntyre, P.; Mori, S.; Reeder, D.D.; Rich, J.; Rubbia, C.; Stefanski, R.; Winn, D. (Fermilab, Batavia, Illinois 60510). *Phys. Rev. Lett.;* **38**: No. 20, 1110-1113(16 May 1977).

We have observed six trimuon events produced by neutrinos in the new large-angle neutrino detector (NEULAND) at Fermilab with the momenta and charges of almost all muons determined. The properties of these events strongly suggest that their origin is not hadronic but may be in the lepton sector.

40553 Coherent regeneration of K/sub s/'s by carbon as a test of Regge-pole-exchange theory. Roehrig, J.; Gsponer, A.; Molzon, W.R.; Rosenberg, E.I.; Telegdi, V.L.; Winstein, B.D.; Kobrak, H.G.E.; Pitt, R.E.; Swanson, R.A.; Aronson, S.H.; Bock, G.J. (Enrico Fermi Institute, University of Chicago, Chicago, Illinois 60637). *Phys. Rev. Lett.;* **38**: No. 20, 1116-1119(16 May 1977).

A measurement of the coherent regeneration amplitude in carbon in the energy range 30—130 GeV is presented. The results are consistent with the dominance of this process by ω exchange, and a precise value of the intercept of the ω trajectory is obtained: α/sub ω/(0) = 0.390 +- 0.014.

STRONG BARYON-INDUCED INTERACTIONS

40554 (BNL—50579, pp 137-168) Production of hypernuclei. Bressani, T. (Univ., Turin); Fanberg, A.T. Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

A critical examination is given of the experimental status of hypernuclei production, and an attempt is made to clarify the most important future developments. The use of negative kaon, proton, and heavy ion beam for hyperfragment production and the search for double hypernuclei are discussed. 35 references. (JFP)

40555 (BNL—50579, pp 201-219) Hypernuclear systematics in strangeness exchange reactions. Gal, A. (Univ. of Virginia, Charlottesville). Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

Reference is made to the (K^-, π^-) hypernuclear spectra for ^{9}Be, ^{12}C, ^{16}O, ^{32}S, and ^{40}Ca targets. Also ΛN parameters, which give evidence in favor and against the emergence of a unique strangeness analog state, and the usefulness of specific hypernuclear decay modes for identifying hypernuclear states are discussed. 17 references. (JFP)

40556 Study of the production of π^+ mesons in the reaction ppyieldsπ^+ pn at 1000 MeV. Vovchenko, V.G.; Zheleznyakov, V.M.; Komarov, E.N.; Polyakov, V.V.; Suslenko, V.K.; Fedorov, O.Y.; Chizhikov, V.I.; Shvedchikov, A.V. (Leningrad Institute of Nuclear Physics, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 608-612(Dec 1976).

Momentum spectra of π^+ mesons in the reaction ppyieldsπ^+pn have been measured at an incident-proton energy 1000 MeV. The π^+-meson spectra were obtained at angles of 30.5degree, 55degree, 70degree, 90degree, 110degree, and 125degree in the center-of-mass system of the colliding protons. It is shown that for satisfactory description of our experimental data by expansion of the angular distribution of the π^+-meson momentum spectra in Legendre polynomials P/sub l/(cosΘ_0) it is necessary to take into account terms up to at least l=4. The results are compared with the predictions of the one-pion-exchange model and with the results of other studies.

40557 Experimental study of the reaction pdyieldsppn near 650 MeV. Golovin, B.M.; Korolev, V.M.; Khamraev, F.S. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 613-616(Dec 1976).

A proton beam of energy about 650 MeV has been used to study the reaction pdyieldsppn. We have determined the spectrum of protons emitted in the reaction at angles Θ_1=52.5 +- 1degree and Θ_2=50 +- 1.5degree. It is shown that for T_0=640 +- 1 MeV and Θ_1=51.5 +- 1.5degree, Θ_2=51.5 +- 1degree, the differential cross section averaged over energies 130 < or =T_1< or =160 MeV is $d^3\sigma/d\Omega_1 d\Omega_2 dT_1$=3.0 +- 0.7 μb/sr^2 MeV. The differential cross section integrated over energy $d^2\sigma/d\Omega_1 d\Omega_2$ for protons emitted at angles Θ_1=40.5 +- 1degree and Θ_2=40.5 +- 1.5degree is found to be $d^2\sigma/d\Omega_1 d\Omega_2$ =272 +- 7 mb/sr^2. Comparison of the experimental data with the results of theoretical calculations has shown that satisfactory description of the data is achieved if we take into account single NN scattering, double NN collisions, and the interaction of nucleon pairs in the final state. The significant role of final-state interactions after double NN scattering is noted.

40558 Investigation of inclusive reactions on nuclei with backward emission of protons in the energy interval 1.5—9.0 GeV. Burgov, N.A.; Vlasov, M.K.; Vorob'ev, L.S.; Gerzon, S.A.; Kiselev, Y.T.; Kosov, M.V.; Leksin, G.A.; Martem'yanov, A.N.; Pivnyuk, N.A.; Stolin, V.L.; Terekhov, Y.V.; Ushakov, V.I. (Institute of Theoretical and Experimental Physics, State Atomic Energy Commission). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 620-622(Dec 1976).

The spectra of the protons emitted from the nuclei C, Al, Ti, Cu, Cd, and Pb at the lab angle 162degree were measured in the inclusive reactions π^- +Ayieldsp+...and p+Ayieldsp+... . It was found that in the secondary-proton momentum interval 0.4<p<1.0 GeV/c the cross sections f depend linearly on the atomic weight A of the target nuclei at initial π^--meson momenta 1.55, 3.10, 5.16, and 6.20 GeV/c and at a proton momentum 9.0 GeV/c. The slope parameter B is independent, within <10%, of A and of the sort of energy of the bombarding particles. The results offer evidence of invariance of the function rho=f/σ/sub t/ (σ/sub t/ is the total cross section of the inelastic interaction of the incident particle with the nucleus). rho becomes independent of energy at initial particle energies approximately-less-than1.5 GeV for the C nucleus and approximately-greater-than5 GeV for the heaviest of the investigated Pb nuclei.

40559 The possibility of studying multiple production of hadrons in collisions of cosmic-ray particles with air nuclei using muon time correlations. Pestov, Y.N.; Tayurskii, V.A.; Fedotovich, G.V. (Institute of Nuclear Physics, Siberian Division, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 657-658(Dec 1976).

From measurements of the muon pairs produced by decaying pions in extensive air showers, information on the nature of the collisions between primary cosmic-radiation particles of energy above 10^{13} eV with atmospheric nuclei is obtained.(AIP)

40560 Search for particle-bound polyneutron systems. Turkevich, A.; Cadieux, J.R.; Warren, J.; Economou, T.; La Rosa, J.; Roland, H. Heydegger. (The Enrico Fermi Institute and Chemistry Department, The University of Chicago, Chicago, Illinois 60637). *Phys. Rev. Lett.;* **38**: No. 20, 1129-1131(16 May 1977).

A search for particle-bound polyneutron systems (^{6}n-^{12}n) produced in ~ 700-MeV proton interactions with uranium has yielded negative results. A radiochemical technique was used. The limits on production cross section: 10^{-3} to 10^{-5} μb: are many orders of magnitude lower than previous limits at comparable energies, are lower than predictions based on extrapolation of yields of other neutron-rich species, and are in contrast to the positive results reported recently from work with 24-GeV protons on tungsten.

STRONG MESON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 40555

40561 (ORO—2504-251) **Resonance production in π^-p interactions at 100 GeV/c. Technical report No. 77-039.** Svrcek, F.C. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Nov 1976. Contract EY-76-C-05-2504. 209p. Dep. NTIS $7.75.

Thesis.

A bubble chamber-wide-gap optical spark chamber experiment has been performed in order to make use of precision momentum measurements (delta p/p less than 0.25) in studying the π^-p interaction at 100 GeV/c. These measurements were used to study phenomenological characteristics of and resonance production in the π^-p interaction. Peyrou plots and single particle inclusive distributions in rapidity, Feynman x, and transverse momentum for π^+, π^-, and p production were used to point out the incident particle and leading proton effects. Factorization of the differential cross section was tested, indicating a slight preference for the variables (rapidity, transverse momentum). Two-particle rapidity correlations as a function of rapidity gap for like and unlike charge pion pairs were investigated inclusively, where short range correlation behavior was noted, and semi-inclusively, where a suggestion that clusters may consist of one positive particle and one negative particle was seen. A search for the production of known resonances was conducted in the following effective mass distributions: ($p\pi^{+-}$), ($\pi^+\pi^-$), ($\pi^+\pi^-\pi^{+-}$), ($\pi^+\pi^-\pi^+\pi^-$), ($K^{+-}\pi^{-+}$), and (K^+K^-). The Δ^{++} (1236) was seen in the ($p\pi^+$) channel, and substantial rho^0(770) was seen in the ($\pi^+\pi^-$) spectrum. Differential cross sections in center of mass rapidity and transverse momentum for the rho^0 indicated the dominance of production in the central and forward rapidity regions and production comparable to that for pions at p^2/sub T/ greater than 0.5 (GeV/c)^2. No other resonances were observed.

40562 Measurement of nucleon and pion form factors in the time-like 4-momentum interval from 1.5 to 3.0 F^{-2}. Berezhnev, S.F.; Blokhintseva, T.D.; Dem'yanov, A.V.; Kuptsov, A.V.; Kurochkin, V.P.; Nemenov, L.L.; Smirnov, G.I.; Khazins, D.M. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 591-594(Dec 1976).

The differential cross sections of the reaction π^-pyieldse$^+$e$^-$n was analyzed within the framework of the dispersion model. A good description of the experimental data is obtained when the pion electric form factor F/sub π/(k^2) is equal to the nucleon Dirac isovector form factor F_1/sup V/(k^2). The form factors were determined for the squared time-like 4-momentum transfer values k^2=1.5, 1.9, 2.3, 2.65, and 3.0 F^{-2}. The mean square pion radius r/sub π/ or nucleon radius r/sup v//sub F/1 is equal to 0.75 +- 0.09 F.

40563 Measurement of differential elastic cross sections for π +- p. Gordeev, V.A.; Koptev, V.P.; Kruglov, S.P.; Kuz'min, L.A.; Kulbardis, A.A.; Malov, Y.A.; Strakovskii, I.I.; Shcherbakov, G.V. (Leningrad Institute of Nuclear Physics, USSR Academy of Sciences, Leningrad). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 599-603(Dec 1976).

The differential elastic cross sections for π^-p and π^+p scattering in the momentum range 400—590 MeV/c have been measured with an accuracy of 2—5%. Our results for both π^-p and π^+p scattering agree with the data of Bussey et al [P. J. Bussey, J. R. Carter, D. R. Dance, B. V. Bugg, and A. A. Carter, Nucl. Phys. B58, 363 (1973)] at 408 MeV/c, but disagree with previous experiments on π^-p scattering. Our results for the total elastic cross sections for π^+p scattering are in good agreement with the results of Davidson et al. [D. Davidson, T. Bowen, P. K. Caldwell, E. W. Jenkins, R. M. Kalbach, D. V. Petersen, A. E. Pifer, and R. E. Rothschild, Phys. Rev. D6, 1199 (1972)]. Our total cross sections for π^-p scattering are about 10% lower than the values found in the literature.

40564 Production Σ^{+-}-hyperons in reactions π^-pyieldsΣ^{+-} + (anything) at the momenta 4.35 and 4.85 GeV/c. Aleshin, Y.D.; Arutyunyants, G.A.; Kiselevich, I.L.; Kulakov, V.P.; Mel'nichenko, I.A.; Nikitin, S.Y.; Silaev, V.I.; Shkarlet, V.D.; Shidlovskii, A.V. (Institute of Theoretical and Experimental Physics of the State Commission on the Use of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 603-607(Dec 1976).

Inclusive spectra of Σ^{+-}-hyperons from the reactions π^-pyieldsΣ^{+-} +M/sub X/ at the momenta 4.35 and 4.85 GeV/c are presented. The data were obtained by processing photographs from the ITEP 2-meter liquid hydrogen chamber and contain information on production cross sections, the polarizations, and the distribution of the structure functions over the variables x, p(longitudinal), and p^2(transverse) for the Σ^{+-}-hyperons.

40565 Associative multiplicity of charged particles and self-similar behavior of semi-inclusive spectra in π^-p interactions at p=40 GeV/c. Abesalashvili, L.N.; Amaglobeli, N.S.; Akhobadze, L.T.; Kutsidi, N.K.; Matveev, V.A.; Makharadze, T.G.; Salukvadze, R.G.; Sisakyan, A.N.; Slepchenko, L.A.; Solov'ev, M.I.; Solomin, A.N.; Tevzadze, Y.V.; Topuridze, M.V.; Fadeev, N.G.; Tsivtsivadze, E.T.; Chargeishvili, M.S.; Shcheglova, L.M. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 623-627(Dec 1976).

We have investigated the behavior of the associative multiplicities <n (y*)> and <n (p/sub perpendicular/)> for charged particles in π^-p interactions at 40 GeV/c. A description is presented of the character of the dependence of the associative multiplicities

on y* and p/sub perpendicular/ within the framework of the previously proposed diffraction—excitation model. Experiments point to the existence of the theoretically predicted similarity relation $<n(p) < [(d\sigma/sub\ n//dp)/(d\sigma/dp)] = Psi(n/<n(p)<)$, which is one of the manifestations of self-similarity in strong interactions.

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

GENERAL

40566 (BNL—50579, pp 45-94) **Symmetry, order and symmetry restoration.** Salam, A. (International Center for Theoretical Physics, Trieste, Italy); Strathdee, J. Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

The basic theory of symmetry restoration is reviewed particularly in relation to a possible vanishing of the Cabibbo angle in the presence of external electromagnetic fields. It is emphasized that the critical quantities are invariants like $(H^2) - (E^2)$. This one, in particular, must exceed $(10^{15}\ gauss)^2$ since theta/sub c/ is not equal to 0 for hyperons. In some nuclei, internal fields exceed this critical quantity, lending credence to the arguments by Hardy and Towner and by Watson that theta/sub c/ has made a transition to an anomalously small value for nuclei like Ar^{35} and Nb^{93}.

ELECTROMAGNETIC INTERACTIONS

40567 **The effect of the field of a colliding beam on bremsstrahlung.** Katkov, V.M.; Strakhovenko, V.M. (Institute of Nuclear Physics, Siberian Section of the Academy of Sciences of the USSR, Novosibirsk). *Sov. Phys. - Dokl. (Engl. Transl.);* **21**: No. 11, 658-659(Nov 1976).

It is shown that the collective effect of colliding beams on the motion of the interacting particles produces the same effect as an external magnetic field.(AIP)

STRONG INTERACTIONS, GENERAL

40568 **Scaling and logarithmic multiplicity in the Landau hydrodynamic model with the most rigid equation of state and with viscosity.** Gorenshtein, M.I. (Ukrainian Republic Center of Metrology and Standardization). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 640-643(Dec 1976).

We consider the hydrodynamic model of multiple production of hadrons with the most rigid equation of state and with viscosity. It is shown that if the viscosity coefficient does not depend on the temperature and is small, then the hydrodynamic model leads to scaling and to logarithmic multiplicity of the secondary particles.

STRONG INTERACTIONS, BARYON NO.=0

40569 (BNL—50579, pp 299-340) **Systematics of baryon resonances.** Capps, R.H. (Purdue Univ., West Lafayette, IN). Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

Baryon resonances are summarized. The quark model is assumed, and various properties of hadrons indicating certain aspects of quarks are pointed out. Emphasis is placed on those resonance properties important for an understanding of quarks. 43 references. (JFP)

40570 (LBL—4851) **Barrelet zeros and elastic $\pi^+ p$ partial waves.** Chew, D.M.; Urban, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1976. 28p. (CONF-760729—7; CONF-760719—32). Dep. NTIS $4.00.

From Topical conference on Baryon Resonances; Oxford, United Kingdom of Great Britain and Northern Ireland (UK) (5 Jul 1976).

A procedure is proposed for constructing low-order partial-wave amplitudes from a knowledge of Barrelet zeros near the physical region. The method is applied to the zeros already obtained for elastic $\pi^+ p$ scattering data between 1.2 and 2.2 GeV cm energies. The partial waves emerge with errors that are straight-forwardly related to the accuracy of the data and satisfy unitarity without any constraint being imposed. There are significant differences from the partial waves obtained by other methods; this can be partially explained by the fact that no previous partial-wave analysis has been able to solve the discrete ambiguity. The cost of the analysis is much less.

STRONG INTERACTIONS, BARYON NO.=1

REFER ALSO TO CITATION(S) 40569

40571 **The multiperipheral cluster model and its comparison with experiment.** Volkov, E.I.; Kanarek, T.I.; Roizen, I.I.; Chernavskii, D.S. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 635-639(Dec 1976).

A particular variant of the multiperipheral cluster model based on the Bethe—Salpeter equation is constructed. In contrast with an earlier version of the model, the present variant has maximally peripheral characteristics and leads to an appreciable cross section for fireball production. The functional dependences which determine the kernel of the integral equation are given, and all the free parameters are fixed. Calculations are made of the one-dimensional distributions in the variables n/sub ch/, $x = 2p/\sqrt{s}$, $y^* = -(1/2)\ln[E\text{-}p/sub\ parallel/)/(E+p/sub\ parallel/)]$, and p/sub perpendicular/, the correlation dependences of $<n_0<$ on n/sub -/ and of $<p/sub\ perpendicular/<$ on p/sub parallel/, and the two-particle correlation functions. A comparison of the calculations with experimental data indicates that the model is in good agreement with experiment at E=70 and 200 GeV (pp) and at E=40 GeV ($\pi^- p$).

40572 **Description of experimental data in a Pomeron theory with α/sub p/(0) <1, and some of its implications.** Volkovitskii, P.E.; Lapidus, A.M.; Lisin, V.I.; Ter-Martirosyan, K.A. (Institute of Theoretical and Experimental Physics, State Atomic Energy Commission). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 648-654(Dec 1976).

It is shown that the experimentally observed growth of the total cross sections σ/sub tot/ and of the slopes B of the diffraction peaks can be described in a natural way only in a theory with $\alpha/sub\ p/(0) = 1+\Delta<1$. The quantity Δ is found to have the value $\Delta = (d\sigma/sub\ tot//d\zeta)\ \sigma^{-1}/sub\ tot/ = (dB/d\zeta)/sup\ B^{-1}/ 0.075$, where $\zeta = \ln(s/2m^2/sub\ N/)$. In the asymptotic energy region, where $\zeta\Delta$very-much-greater-than1, there is an important contribution in the t-channel from the exchange of a jet consisting of a large number of Pomerons, n, given by $n \sim \exp(\zeta\Delta)$. This jet has a formal factorization property and leads to a Froissart behavior $\sigma/sub\ tot/ \sim \zeta^2$ for the total cross sections; we therefore call it a "Froissaron." With a simple exponential parametrization of the Regge vertices, the differential cross sections can be fitted only up to t approximately-less-than0.1—0.2 $(GeV/c)^2$. To describe the experimental data for t approx.1 $(GeV/c)^2$, we require vertices with a more complicated t-dependence. The behavior with $\alpha/sub\ p/(0) < 1$ is consistent with the unitarity condition and with inclusive sum rules. "Froissarons" can be used to construct "enhanced" graphs, which appear to give a small contribution.

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

40573 (BNL—50579, pp 221-244) **Experimental measurements of particle properties and string interactions effects in kaonic, antiprotonic, and sigma hyperonic atoms.** Welsh, R.E. (Coll. of William and Mary, Williamsburg, VA). Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

Experimental research on the properties of kaonic, antiprotonic, and sigma minus hadronic atoms is summarized including examples from recent research. 64 references. (JFP)

40574 (BNL—50579, pp 365-382) **Kπ experiments at CERN.** Povh, B. (Max-Planck-Institut fuer Kernphysik, Heidelberg, Ger.). Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

Hypernuclear physics using Kπ experiments is discussed also including gamma spectroscopy, lambda as a nuclear probe, recoilless lambda production, and present experiments in progress. 8 references. (JFP)

40575 (BNL—50579, pp 391-396) **Lambda—nucleus coupling to collective modes.** Feshbach, H. (Massachusetts Inst. of Tech., Cambridge). Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

A speculative discussion of the lambda-nucleus coupling to collective modes in hypernuclei is given treating the hypernuclear structure and properties. (JFP)

40576 (BNL—50579, pp 397-406) **Excitation and microscopic description of unitary analog states.** Kisslinger, L.S. (Carnegie Mellon Univ., Pittsburgh). Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

A composite of two previous talks is given rather than a review of unitary analog states of hypernuclei. The reaction mechanism, the doorway-isobar model for kaon potentials, and hypernuclear structure and unitary analog states are treated. 12 references. (JFP)

40577 (BNL—50579, pp 407-431) **Nuclear and particle physics of exotic atoms.** Alberg, M. (Univ. of Washington, Seattle). Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

The nuclear and particle physics of hadronic atoms is discussed from the viewpoint of the construction of a hadron-nucleus optical potential. Several types of theoretical models are compared in order to illustrate the respective roles of nuclear and particle physics at various stages of the theory. The KN interaction, optical potentials, strong interaction shifts and widths, and antiprotonic atoms are considered. 27 references. (JFP)

40578 **Distribution in rapidity intervals and their significance for the understanding of clustering.** Adamovich, M.I.; Volkov, E.I.; Larionova, V.G.; Tret'yakova, M.I.; Kharlamov, S.P.; Chernyavskii, M.M.; Yagudina, F.R. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 627-631(Dec 1976).

Two multi-cluster theory variants that are essentially different in the degree of clustering are compared with experiments on pp interactions at E=70 and 200 GeV. It is shown that all the presently employed distributions of n/sub -/ in terms of n/sub ch/, x=2p/sub parallel/*/√s, y*= (1/2)ln[(E +p/sub parallel/*)/(E-p/sub parallel/*)], p/sub perpendicular/, or <n_e< cannot reveal the differences between the proposed theoretical models, and only a set of distributions in rapidity intervals offers such a possibility.

40579 **The A-dependence of the hadron—nuclear inelasticity coefficient at high energies.** Lytkin, L.K.; Nikanorov, V.I. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 631-632(Dec 1976).

A connection is obtained between the hadron—hadron inelasticity coefficient and the "asymptotic" cross section for hadron—nucleon interactions. The experimental data are analyzed.

40580 **The mechanism of cumulative hadron production on nuclei.** Efremov, A.V. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 633-634(Dec 1976).

A mechanism analogous to the production of hadrons with large p/sub perpendicular/ is proposed for the production of cumulative hadrons on nuclei. The expression obtained for the cross section accounts correctly for the main qualitative features of the behavior of these processes, namely the dependence on the initial energy, on the atomic number, on the mass of the emitted particle, and on the particle emission angle.

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS

40581 **Spontaneous breakdown of muon-number conservation and off-diagonal neutral currents.** Beg, M.A.B.; Sirlin, A. (The Rockefeller University, New York, New York 10021). *Phys. Rev. Lett.;* **38**: No. 20, 1113-1116(16 May 1977).

We suggest that the conservation of muon number is associated with a local gauge principle and that small nonconservation effects develop from the spontaneous breakdown of the gauge symmetry. Experimental consequences of the scheme, stemming from the spontaneous genesis of off-diagonal neutral currents, are discussed in detail.

APPLICATIONS TO STRONG INTERACTIONS

40582 **Tests of models of SU (3) -symmetry breaking for vector mesons.** Kozhevnikov, A.A.; Shestakov, G.N. (Mathematical Institute of the Siberian Section of the USSR Academy of Sciences, Novosibirsk). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 643-647(Dec 1976).

The possibility of an effective choice between models of SU (3) -symmetry breaking in reactions with the participation of vector mesons is considered in detail. It is shown that in the reactions e^+e^- yields3π and e^+e^- yields$\pi^0\gamma$ the position of the minimum in the cross sections relative to the phi-resonance is quite sensitive to the choice of model. In two-particle decays the most critical tests of the models are the ratios of the widths Γ (phiyieldsKK)/Γ (K*yieldsKπ) and Γ (phiyieldsKK)/Γ (rhoyields$\pi\pi$), and the interpretation of other tests of this type is ambigous owing to errors in the characteristics of the resonances. The majority of indications speak in favor of the mass-mixing model.

FIELD THEORY

40583 **Symmetries of ultralocal quantum field theories.** DeFacio, B.; Hammer, C.L. (Ames Laboratory-ERDA, Iowa State University, Ames, Iowa 50011). *J. Math. Phys. (N.Y.);* **18**: No. 6, 1216-1223(Jun 1977).

The symmetries of the gradient free ultralocal model quantum field theories are studied. The internal parameter λ introduced by J. R. Klauder is replaced by an r-component vector and used to obtain an r-vector ultralocal field operator phi-tilde. Then ultralocal many-body models with translational and rotational symmetry are set up by partitioning lambda yields into N, 3-d "relative internal coordinates." Hartree-type 1/N limits are studied in this model and found to be accurate only if contributions from lambda yields $<<0$ are negligible. A brief sketch is given of how to produce more general U/sub N/ and pairing interaction ultralocal models.

SCATTERING THEORY

40584 **Variational methods for chemical and nuclear reactions.** Crawford, O.H. (Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Math. Phys. (N.Y.);* **18**: No. 6, 1241-1255(Jun 1977).

All the variational functionals are derived which satisfy certain criteria of suitability for molecular and nuclear scattering, below the threshold energy for three-body breakup. The existence and uniqueness of solutions are proven. The most general suitable functional is specialized, by particular values of its parameters, to Kohn's taneta, Kato's cot(eta-θ), the inverse Kohn coeta, Kohn's S matrix, our S matrix, Lane and Robson's functional, and several new functionals, an infinite number of which are contained in the general expression. Four general ways of deriving algebraic methods from a given functional are discussed, and illustrated with specific algebraic results. These include equations of Lane and Robson and of Kohn, the fundamental R matrix relation, and new equations. The relative configuration space is divided as in the Wigner R matrix theory, and trial wavefunctions are needed for only the region where all the particles are interacting. In addition, a version of the general functional is presented which does not require any division of space.

NUCLEAR PHYSICS

40585 (LA—6723-PR) **Applied nuclear data research and development. Progress report, July 1—September 30, 1976.** Baxman, C.I.; Young, P.G. (comps.). (Los Alamos Scientific Lab., N.Mex. (USA)). Feb 1977. Contract W-7405-ENG-36. 49p. P 03/MF A01.

This progress report describes the activities of the Los Alamos Nuclear Data Group for the period July 1 through September 30, 1976.

40586 (NP—21778) **Annual report, 1976.** (Ankara Nuclear Research and Training Center (Turkey)). 1976. 20p. U 02/MF A01.

The Ankara Nuclear Research and Training Center carries out applied research and development work, most of which is directly related to Turkish industry. The Center consists of the following eight departments: nuclear physics, nuclear chemistry, electronics, radioisotope applications in industry, health physics, agricultural and biological radioisotope applications, technical information, and technical services. Very brief, nontechnical summaries of work done are presented. (RWR)

40587 (ORO—4936-2) **Progress report on nuclear spectroscopic studies, June 1, 1976—May 31, 1977.** Bingham, C.R.; Riedinger, L.L. (Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy). 1 Mar 1977. Contract E(40-1)-4936. 77p. Dep. NTIS $5.00.

Separate abstracts have been prepared for 10 sections for appearance in ERA. (SDF)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

40588 **Diffractive disintegration of three-nucleon nuclei.** Levshin, E.B.; Foursat, A.D. (Institute for Nuclear Research, Academy of Sciences, Ukrainian SSR). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 585-590(Dec 1976).

A theoretical analysis of the two-particle disintegration reaction ^{3}He(p,2p) d is performed using multiple-scattering diffraction theory generalized to include the case of one deep-inelastic collision. Numerical results are obtained for 155-MeV protons. Gaussian-type model functions with parameters adjusted to fit electrodisintegration data were used to describe the nuclear ground states. The sensitivity of the reaction cross sections to the parameters of the nucleon—nucleon interaction amplitude are analyzed and the role of final-state interactions is studied.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 40590

40589 **Measurement of the yields of the nuclear-reaction products with a mass spectrometer on-line with a proton accelerator at E/sub p/=1 GeV.** Belyaev, B.N.; Domkin, V.D.; Korobulin, Y.G.; Krizhanskii, L.M. (V. G. Khlopin Radium Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 617-619(Dec 1976).

We describe a mass spectrometer operating "on-line" with the synchrocyclotron of the Leningrad Institute of Nuclear Physics using an extracted proton beam of energy E/sub p/=1 GeV. This instrument was tested with a thermoionization source of ions intended for the measurement of the yields of alkali isotopes in the products of nuclear reactions. Results were obtained on the yields of the isotopes of lithium (^{6}/sup ,/^{7}/sup ,/^{8}/sup ,/^{9}Li) in a carbon target. These data are of interest in the examination of the formation of elements in cosmic rays. With ^{90}Zr and ^{94}Zr targets, we obtained the relative yields of the spallation reaction Zr(p,4pxn)Rb and some results on the production of sodium fragments. The data on rubidium indicate that the yield of the isotopes with even number of neutrons is 15—20% higher than that of isotopes with an odd number of neutrons. This fact is attributed to a difference between the neutron binding energies, which reaches approximately 3 MeV for these isotopes and exerts a predominant influence on the last stages of the evaporation process.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

40590 (LBL—5077) **Two-proton pickup studies with the (^{6}Li,^{8}B) reaction.** Weisenmiller, R.B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 3 Dec 1976. Contract W-7405-ENG-48. 132p. Dep. NTIS $6.00.

Thesis.

The (^{6}Li,^{8}B) reaction has been investigated on targets of ^{26}Mg, ^{24}Mg, ^{16}O, ^{13}C, ^{12}C, ^{11}B, ^{10}B, and ^{9}Be at a bombarding energy of 80.0 MeV, and on targets of ^{16}O, ^{12}C, ^{9}Be, ^{7}Li, and ^{6}Li at a bombarding energy of 93.3 MeV. Only levels consistent with direct, single-step two-proton pickup reaction mechanisms were observed to be strongly populated. On T/sub z/ = 0 targets, the spectroscopic selectivity of this reaction resembles that of the analogous (p,t) reaction. Additionally, these data demonstrate the dominance of spatially symmetric transfer of the two protons. On T/sub z/ greater than 0 targets the (^{6}Li,^{8}B) reaction was employed to locate two previously unreported levels (at 7.47 +- 0.05 MeV and 8.86 +- 0.07 MeV) in the T/sub z/ = 2 nuclide ^{24}Ne and to establish the low-lying 1p-shell states in the T/sub z/ = $^{3}/_{2}$ nuclei ^{11}Be, ^{9}Li, and ^{7}He. However, no evidence was seen for any narrow levels in the T/sub z/ = $^{3}/_{2}$ nuclide ^{5}H nor for any narrow excited states in ^{7}He. The angular distributions reported here are rather featureless and decrease monotonically with increasing angle. This behavior can be shown by a semi-classical reaction theory to be a consequence of the reaction kinematics. A semi-classical approach also suggests that the kinematic term in the transition matrix element is only weakly dependent upon the angular momentum transfer (which is consistent with simple Distorted Wave Born Approximation calculations). However, only qualitative agreement was obtained between the observed relative transition yields and semi-classical predictions, using the two-nucleon coefficients of fractional parentage of Cohen and Kurath, probably due to the limitations of the semi-classical reaction theory.

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

40591 (ANL/NDM—27) **Evaluated (n,p) cross sections of ^{46}Ti, ^{47}Ti and ^{48}Ti.** Philis, C.; Bersillon, O.; Smith, D.; Smith, A. (Argonne National Lab., Ill. (USA)). Jan 1977. Contract W-31-109-ENG-38. 19p. Dep. NTIS $3.50.

Microscopic evaluated neutron cross sections for the reactions ^{46}Ti(n;p)^{46}Sc, ^{47}Ti(n;p)^{47}Sc and ^{48}Ti(n;p)^{48}Sc are obtained from threshold (or zero energy) to 20 MeV. The results are presented in graphical and numerical (ENDF format) form. The microscopic evaluated cross sections are compared with measured fission-spectrum-averaged values.

40592 (EURFNR—1379) **Total neutron cross section of ^{58}Fe in the energy range 7 to 325 keV.** Beer, H.; Hong, L.D.; Kaeppeler, F. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Angewandte Kernphysik). Aug 1976. 19p. (KFK—2337). U 02/MF A01.

Work performed under United States—Euratom Fast Reactor Exchange Program.

The total neutron cross section of ^{58}Fe has been determined in the energy range 7-325 keV by a transmission measurement using enriched ^{58}Fe samples. The data have been shape fitted by means of an R-matrix multi-level formalism to extract resonance parameters for s- and l greater than 0 wave resonances. The s-wave strength function was determined to $S_0 = (4.3 +- 1.9) \times 10^{-4}$.

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

40593 (ORO—4936-2, pp 40-42) **Coulomb nuclear interference—inelastic scattering of heavy ions.** 1 Mar 1977.

In Progress report on nuclear spectroscopic studies, June 1, 1976—May 31, 1977.

The differential cross section is reported for excitation of the 4.43 MeV state of 70.4 MeV ^{12}C projectiles through scattering from ^{144}Nd. Data are fit with both prolate and oblate parameters. (SDF)

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

40594 (ORO—4936-2, pp 37-39) **^{185}Au.** 1 Mar 1977.

In Progress report on nuclear spectroscopic studies, June 1, 1976—May 31, 1977.

Progress is reported for a study of energy bands in ^{185}Au populated in the (^{20}Ne, 4nγ) reaction. Results of the h 9/2 band are given. (SDF)

40595 (ORO—4936-2, pp 48-55) **Coulomb excitation.** 1 Mar 1977.

In Progress report on nuclear spectroscopic studies, June 1, 1976—May 31, 1977.

Trends of 2^{+} and 0^{+} states in Yb nuclei and measured B(E2; 0^{+} yields 2^{+}) values are reported. (SDF)

40596 (ORO—4936-2, pp 56-57) **^{164}Er—Berkeley.** 1 Mar 1977.

In Progress report on nuclear spectroscopic studies, June 1, 1976—May 31, 1977.

The intersecting crossing band structure of the backbending nucleus ^{164}Er is illustrated. (SDF)

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

REFER ALSO TO CITATION(S) 40601

RADIOACTIVE DECAY

40597 (ORO—4936-2, pp 26-29) **^{200}Po and ^{200}Bi decay.** Bingham, C.R.; Riedinger, L.L. 1 Mar 1977.

In Progress report on nuclear spectroscopic studies, June 1, 1976—May 31, 1977.

A preliminary decay scheme is presented for the decay of ^{200}Po to levels in ^{200}Bi. (SDF)

40598 (ORO—4936-2, pp 7-15) **^{195,197}Pb decay.** 1 Mar 1977.
In Progress report on nuclear spectroscopic studies, June 1, 1976—May 31, 1977.
Partial decay schemes are presented for the decay of ^{195,197}Pb to levels in ^{195,197}Tl. (SDF)

40599 (ORO—4936-2, pp 21-25) **^{196}Pb decay.** 1 Mar 1977.
In Progress report on nuclear spectroscopic studies, June 1, 1976—May 31, 1977.
A preliminary decay scheme for the ^{196}Pb decay to levels in ^{196}Tl is compared with other odd-odd nuclei in this region. (SDF)

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 40597, 40598, 40599

40600 (ORO—4936-2, pp 30-36) **In-beam spectroscopy.** 1 Mar 1977.
In Progress report on nuclear spectroscopic studies, June 1, 1976—May 31, 1977.
Results of level studies of ^{191,193}Tl populated in (HI, xnγ) reactions, are reported. (SDF)

40601 (ORO—4936-2, pp 16-20) **Triaxial h/sub 9/2/ band in Tl.** 1 Mar 1977.
In Progress report on nuclear spectroscopic studies, June 1, 1976—May 31, 1977.
Systematics of the h 9/2 levels in ^{193,195,197}Tl are presented and compared with a triaxial rotor calculation. (SDF)

NUCLEAR REACTIONS AND SCATTERING

40602 **Evidence for slowly moving, highly excited nuclear matter produced in high-energy nucleus-nucleus collisions.** Stevenson, J.; Price, P.B.; Frankel, K. (Department of Physics, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* **38**: No. 20, 1125-1129(16 May 1977).
In the reactions 20-GeV Ar + Au and 8-GeV Ne + U, the angular and energy distributions of six nuclei with Z < or = 3 imply approximately isotropic emission from systems moving at β_0 0.04 to 0.11. The invariant cross sections fit either Maxwellians (tau 52 to 63 MeV) or exponential in momentum (P_0 240 to 300 MeV/c) in the moving frame. The low β_0 and high tau are inconsistent with emission of nuclei (Z < or = 3) from a recoiling fireball unless extreme assumptions are made; they thus imply nonthermal emission.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

REFER ALSO TO CITATION(S) 40603

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

40603 (TID—3317-S7) **Transplutonium elements. A bibliography.** Stuber, C.E. (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Nov 1976. 148p. Dep. NTIS $6.00.
This bibliography comprises 727 references compiled through the period October 30, 1976, to June 30, 1976. The references were retrieved from the Nuclear Science Abstracts (NSA) data base using a computerized information retrieval system and were formatted for publication with indexes by computer. Subject descriptors are included to reflect the information content of each article. Part I includes 491 references dealing with the production and chemical, nuclear, physical, and biological properties and health, safety, and environmental aspects of elements with Z greater than or equal to 95. Part II includes 24 references dealing with the natural occurrence of the transplutonium elements. Part III contains 212 references on the environmental aspects of neptunium and plutonium. Author, report number, and subject indexes are included.with attempts to locate or prove the existence of the transplutonium elements in nature. Part III contains 212 references on the environmental aspects of neptunium and plutonium. Author, report number, and subject indexes are included.

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 40604

ENERGY LEVELS AND TRANSITIONS

40604 **Two-quasiparticle states in ^{250}Cf populated by electron capture decay of 8.6-h ^{250}Es isomer.** Freedman, M.S.; Ahmad, I.; Porter, F.T.; Sjoblom, R.K.; Barnes, R.F.; Lerner, J.; Fields, P.R. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* **15**: No. 2, 760-776(Feb 1977).
The electron capture decay scheme of the 8.6+-0.1-h ^{250}Es isomer was investigated with high-resolution γ ray and β-ray spectrometers and with two parameter coincidence analysis. Mass-separated samples of ^{250}Es produced by ^{249}Bk(α,3n) and ^{249}Cf(d,n) reactions were used for these measurements. We propose a decay scheme involving 32 transitions and 16 levels in ^{250}Cf. In addition to the ground state band, six rotational bands have been identified. The energies (keV) and Kπ values of the bandheads are 871.67 (2-), 1031.80 (2+), 1255.49 (4-), 1396.18 (5-), 1478.47 (5-), and 1499.62 (6-). The logft values of the electron capture transitions to the four highest bands were deduced, and these were used to elucidate the principal two-quasiparticle components of these states. The Kπ = 2 - and 2 + bands were interpreted as octupole and γ-vibrational bands. The following two-quasiparticle configurations have been assigned: 1255.49 (4-), {n[734]9/2-; n[620]1/2+}; 1396.18 (5-), {p[633]7/2+; p[521]3/2-}; 1478.47 (5-), {n[734]9/2-; n[620]1/2+}; and 1499.62 (6-), {n[734]9/2-; n[622]3/2+}. The ground state of the 8.6-h ^{250}Es isomer has been given a spin—parity assignment of 6+ with the configuration {n[734]9/2-; p[521]3/2-}. KLL Auger energies and intensities for Z = 98 are reported. A K fluoresence yield of 0.976+-0.005 is obtained for Cf.

NUCLEAR REACTIONS AND SCATTERING

40605 (DP—1447) **Evaluation of neutron cross sections for ^{244}Cm, ^{246}Cm, and ^{248}Cm.** Benjamin, R.W.; McCrosson, F.J.; Gettys, W.E. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Jan 1977. Contract E(07-2)-1. 31p. Dep. NTIS $4.00.
An evaluation of neutron cross sections for $^{244\ 246\ 248}$Cm using the ENDF/B format is presented. Primary data input included differential measurements, integral measurements, nuclear model calculations, and reactor production experience. (SDF)

40606 (ORO—4936-2, pp 44-47) **Coulomb-nuclear interference for heavy-ion scattering from highly-deformed nuclei.** 1 Mar 1977.
In Progress report on nuclear spectroscopic studies, June 1, 1976—May 31, 1977.
Preliminary γ spectra data are presented for ^{86}Kr + ^{232}Th scattering at lab energies of between 351 and 437 MeV. Extracted excitation probabilities for 10^+, 12^+, 14^+ and 16^+ + 18^+ states are also given. (SDF)

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 40605

40607 (UCID—17370) **Measurement of the neutron-induced fission cross section of ^{237}Np relative to ^{235}U from 0.02 to 30 MeV.** Behrens, J.W.; Magana, J.W.; Browne, J.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Jan 1977. Contract W-7405-ENG-48. 8p. Dep. NTIS $3.50.
The ^{237}Np/^{235}U fission cross section ratio has been measured from 0.02 to 30 MeV. Using the threshold method, a value of 1.294 +- 0.019 is obtained for the average cross section ratio in the interval from 1.75 to 4.00 MeV.

40608 **Investigation of conversion electrons in fission of ^{235}U by thermal neutrons.** Popeko, L.A.; Petrov, G.A.; Rudnev, Y.P.; Kochubei, E.F. (Leningrad Institute of Nuclear Physics, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 567-570(Dec 1976).
The electron spectra from fission of ^{235}U by thermal neutrons have been studied in the energy region 150—1500 keV. In the delayed electron radiation we have observed lines with energy 843 +- 3 keV, half-life 65 +- 10 nsec, and intensity (2.5 +- 0.5) x 10^{-4} electrons/fission, which can be explained by an isomeric E0 transition in ^{96}Zr. It is shown that the yield of electrons due to the fluctuation electromagnetic field of the fissioning nucleus is < or = 10^{-4} electrons/fission. Confirmation is obtained for the dominant contribution of E2 transitions to the prompt γ-ray spectrum of the fission fragments.

40609 **Barriers for fragments in fission of ^{232}Th by neutrons.** Lisin, S.K.; Morozov, L.N.; Pchelin, V.A.; Chistyakov, L.V.; Shigin, V.A.; Shubko, V.M. (I. V. Kurchatov Atomic Energy Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 570-575(Dec 1976).
To clarify the causes of asymmetry in fission, the yields of the various fragments in fission of ^{232}Th by neutrons have been studied as a function of neutron energy. Particular attention has been devoted to the vicinity of the fission threshold. A radiochemical method

was used to identify the fragments. It was found that symmetric fission has a barrier at a neutron energy E/sub n/=2 MeV of height B=7 MeV. Most probable fission has a barrier at E/sub n/=1.3 MeV of height B=6.3 MeV. These and most of the other results which have been obtained are explained in terms of a model with two fission barriers, both in the Strutinskii model and in the molecular model. With this explanation the 6.3-MeV barrier turns out to be common for all fragments, while the second barrier is different for different fragments: for symmetric fission it is located at 7 MeV, and for most probable fission, somewhat below 6.3 MeV.

40610 Upper limit for the cross section of ^{226}Ra for fission by thermal neutrons. Kuks, I.M.; Nemilov, Y.A.; Nikolaev, V.A.; Seleznev, E.V.; Selitskii, Y.A.; Funshtein, V.B. (V. G. Khlopin Radium Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 659-660(Dec 1976).

By means of a control experiment using U^{235} fission fragments, a new smaller value for the fission cross section of Ra^{226} by thermal neutrons is determined. The measurements required a 15-day irradiation.(AIP)

NUCLEAR THEORY

REFER ALSO TO CITATION(S) 40566

NUCLEAR STRUCTURE

REFER ALSO TO CITATION(S) 40612

40611 (BNL—50579, pp 9-44) **Qualitative features of the K^+ as a probe of nuclear structure.** Dover, C.B. Dec 1976.

From Summer study on kaon physics and facilities; Upton, New York, United States of America (USA) (1 Jun 1976).

In Proceedings of the summer study meeting on kaon physics and facilities.

The advantages of the use of low energy (0 to 800 MeV/c) K^+ mesons as a probe of nuclear structure are considered. Qualitative features of the K^+- and K^--nucleon interactions, strongly and weakly absorbed probes, the optical potential for K^+-nucleus scattering, survey of typical predicted K^+-nucleus cross sections, comparison with emulsion data, and the nuclear structure aspects are discussed. 28 references. (JFP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 40611

NUCLEAR MODELS

40612 Microscopic model for damping of giant resonances. Rumyantsev, B.A. (Institute of Nuclear Physics, Siberian Division, Academy of Sciences of the USSR). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 575-580(Dec 1976).

The theory of the damping of collective nuclear vibrations is developed in the framework of the Bogolyubov correlation-function method [N. N. Bogolyubov, Problemy dinamicheskoi teorii v statisticheskoi fizike (Problems of a Dynamical Theory in Statistical Physics), Gostekhizdat, 1946; Zh. Eksp. Teor. Fiz. 16, 691 (1946); N. N. Bogolyubov and K. P. Gurov, Zh. Eksp. Teor. Fiz. 17, 614 (1947)]. The physical basis for this work is the mechanism found by Landau for the damping of zero sound in a Fermi liquid [L. D. Landau, Zh. Eksp. Teor. Fiz. 32, 59 (1957)].

40613 A certain relation between the method of hyperspherical functions and the shell model. Sadovoi, A.A.; Aver'yanov, I.K.; Golubev, A.I. *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 581-584(Dec 1976).

It is shown for nuclei with more than 10 nucleons that the MHSF (method of hyperspherical functions) formulas for the distributions of charge, neutrons, and nuclear matter can be reduced to the corresponding formulas of the independent-particle model (IPM) with an effective oscillator potential whose frequency is expressed in terms of the MHSF parameters. The numerical calculations made, demonstrate agreement of the results to within 0.5% for calculations according to the exact and approximate formulas. The differences between MHSF and the independent-particle model are discussed.

40614 Motion of a particle in an axially symmetric potential with an arbitrary deformation. Belyaev, V.B.; Wrzecionko, E.; Irgaziev, B.F. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **24**: No. 6, 654-657(Dec 1976).

A procedure is developed which enables one to find in a rather simple way solutions of the Lippman—Schwinger equation with an axially symmetric potential having an arbitrary deformation. Solutions to the scattering and bound-state problems are found for the Gaussian axial potential.

40615 Pion-exchange contributions to the nuclear charge, current, and Hamiltonian operators. Friar, J.L. (Department of Physics, Brown University, Providence, Rhode Island 02912). *Ann. Phys. (N.Y.);* **104**: No. 2, 380-426(Apr 1977).

Using a Foldy-Wouthuysen reduction procedure and the time-dependent perturbation theory, we have calculated the one-pion-exchange contribution to the nuclear charge and current densities to order $(v/c)^2$. At the same time a renormalization scheme defines the pion-exchange potential including nonstatic and three-body correction terms of order $(v/c)^2$. The requirements of relativity are investigated, and it is found that the retardation effect in the potential and charge density plays a critical role. The covariance conditions for the potential, charge, and current densities are shown to be satisfied to the order we have calculated. Finally, the deuteron case is discussed in detail. Throughout the calculation the role of the equivalence theorem is stressed.

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

REFER ALSO TO CITATION(S) 40043

40616 Relationship between the normalization coefficient and dispersion function for the multigroup transport equation. Feigenbaum, M.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg, VA). *J. Math. Phys. (Cambridge, Mass.);* **17**: No. 5, 614-617(May 1976).

An explicit formula for the discrete Case normalization coefficient is presented in terms of functions related to the dispersion function. These functions are easily determined and provide the normalization coefficient without need of prior evaluation of the eigenvectors.

40617 Transmission and absorption of 5—30 keV electrons in bulk solids. Vyatskin, A.Y.; Kabanov, A.N.; Smirnov, B.N.; Khramov, V.Y. (Institute of Precision Mechanics and Optics, Leningrad). *Sov. Phys. - Solid State (Engl. Transl.);* **19**: No. 1, 157-158(Jan 1977).

The Fim-bulk solid method was used to measure the absorption and transmission of 5—30 keV electrons incident on Al, Cn, Au, Ge, and Si.(AIP)

40618 Higher-order Z_1 effects and effects of screening by bound K electrons on the electronic stopping of channeled ions. Datz, S.; Gomez del Campo, J.; Dittner, P.F.; Miller, P.D.; Biggerstaff, J.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev. Lett.;* **38**: No. 20, 1145-1148(16 May 1977).

The stopping power in {111} Au for channeling ions which have not changed charge has been measured for bare nuclei for Z = 1 - 5 at 3.5 MeV/amu, and for ions bearing 0, 1, and 2 bound electrons for Z_1 = 1 - 9 at 2 MeV/amu. An effective screening of ~0.9e per electron is obtained. For the bare nculei, deviations from simple $Z_1^{\ 2}$ scaling are reported. At 2 MeV/amu an increase of 3.5% in $S/Z_1^{\ 2}$ is seen from H to He, 3% from He to Li; but no differences are seen from Z_1 = 5 - 9. However, at 3.5-MeV/amu deviations of as much as 20% per Z_1 are observed.

SHIELDING CALCULATIONS AND EXPERIMENTS

REFER ALSO TO CITATION(S) 39540

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 40256, 40257, 40258, 40259, 40262, 40263, 40264, 40265, 40266, 40267, 40268, 40269, 40270, 40271, 40272, 40273, 40274, 40275, 40276, 40277, 40278

MEDICAL PHYSICS

RADIATION SOURCE CALIBRATION AND STANDARDIZATION

40619 (N—76-27594) **Calibration of cobalt-60 for the Dutch Royal Air Force.** Aten, J.B.T. (Rijksverdedigingsorganisatie TNO, Rijswijk (Netherlands). Medisch Biologisch Lab. TNO). Nov 1975. Contract A71/KL/037. 13p. (MBL—1975-26; TDCK—67112). NTIS $3.50.

Radiac survey meters, for the use of the Dutch Royal Air Force, are checked periodically by using cobalt-60 with well-known activity. Owing to the rather short half-life of cobalt-60 (5.26 years), these sources have to be renewed at regular intervals. To satisfy the legal regulations the reactivated sources have to be tested for leakage and contamination and the activity, quoted by the manufacturer, has to be confirmed. The way, in which the various checks were performed, is described. (auth)

40620 Proton—beryllium neutron production at 25—55 MeV. Johnsen, S.W. (Crocker Nuclear Laboratory, University of California, Davis, California 95616). *Med. Phys.;* **4**: No. 3, 255-258(May 1977).

The production of neutrons by stopping 25-, 35-, 45-, and 55-MeV protons in beryllium has been studied. The yield of neutrons in the forward direction can be approximated by the relation: yield =-0.032 x 10^{16}xE+0.0027 x 10^{16}xE^2 neutrons/C sr. The neutron spectra are characterized by a low-energy evaporation component which has small angular dependence and a high-energy component which is peaked in the forward direction. Neutrons produced in the forward direction have an average energy approximately 40% of the incident proton energy.

DOSIMETRY

40621 (N—76-27161) Computer subroutines for the estimation of nuclear reaction effects in proton-tissue-dose calculations. Wilson, J.W.; Khandelwal, G.S. (National Aeronautics and Space Administration, Langley Station, Va. (USA). Langley Research Center). Jun 1976. 25p. (NASA-TM-X—3388). NTIS $3.50.

Calculational methods for estimation of dose from external proton exposure of arbitrary convex bodies are briefly reviewed. All the necessary information for the estimation of dose in soft tissue is presented. Special emphasis is placed on retaining the effects of nuclear reaction, especially in relation to the dose equivalent. Computer subroutines to evaluate all of the relevant functions are discussed. Nuclear reaction contributions for standard space radiations are in most cases found to be significant. Many of the existing computer programs for estimating dose in which nuclear reaction effects are neglected can be readily converted to include nuclear reaction effects by use of the subroutines described herein. (auth)

SUPERCONDUCTIVITY

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 39851, 39900

40622 Flux change in type II superconductors induced by moving dislocations. Galligan, J.M. (Univ. of Connecticut, Storrs); Pang, C.S.; Tregilgas, J.H.; Van Saun, P.; Suenaga, M. *J. Electron. Mater.;* **4**: No. 5, 891-897(1975).

The mixed state of a type II superconductor has been studied in the presence of moving dislocations. It is found that when dislocations move during plastic deformation there is a change in A.C. permeability which is reversible, with the mobile dislocations supplying the driving force for the transition. Such a transition has been observed in various lead based alloys, independent of the grain size, degree of homogeneity or heat-treatment.

THEORETICAL PHYSICS

CLASSICAL AND QUANTUM MECHANICS

40623 Linear relativistic Hamiltonians. Guertin, R.F.; Trahern, C.G. (Rice Univ., Houston, TX). *Ann. Phys. (N.Y.);* **98**: No. 1, 50-69(May 1976).

A 2(2J + 1)-component relativistic Hamiltonian H that describes free particles of mass m and spin J is said to be linear if it has the form H = hx . p + gm, where x = i[H,x]/sub -/, h is a numerical factor, and g commutes with x and p. All such Hamiltonians are found, provided that the metric is either the unit matrix or rho_3 and provided that the theory is invariant under the discrete symmetries. If the operator GAMMA in the generator K = ½[x, H]/sub +/ + GAMMA of Lorentz boosts is required to be local, there are only two possibilities: either GAMMA = 0, which generalizes the Dirac spin-½ theory, or GAMMA = rho_3(1/2m)S x p, which generalizes the Sakata—Taketani spin-0 and spin-1 theories. The relationship to linear manifestly covariant equations and its significance is discussed.

STATISTICAL PHYSICS AND THERMODYNAMICS

40624 Thermodynamic relations for shock waves in materials with a linear relation between shock-wave and particle velocities. Rodean, H.C. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *J. Appl. Phys.;* **48**: No. 6, 2384-2395(Jun 1977).

The Rankine-Hugoniot relations for shock waves and the empirical linear relation between the shock-wave and particle velocities define an incomplete thermodynamic description of the states along the Hugoniot curve. This incomplete description defines the following along the Hugoniot: (1) internal energy and pressure as functions of specific volume, (2) the ratio of enthalpy to internal energy, (3) the ratio of the changes in enthalpy and internal energy across a shock wave, and (4) the relation between the Grueneisen coefficient and the effective isentropic exponent. We use the Dugdale-MacDonald relation for the Grueneisen coefficient at low pressure, an assumed constant value for the specific heat at constant volume, and reasonable physical assumptions for extremely strong shock waves together with the incomplete thermodynamic state description to define the following along the Hugoniot: (5) the Grueneisen coefficient, (6) the effective isentropic exponent, (7) the ratio of specific heats, and (8) thermal and elastic components of pressure, temperature, and entropy. We present representative numerical values of these parameters as functions of reduced volumetric compression. We show how the solutions for these parameters define tangent planes to the surfaces of the incomplete E,P, and V and P,V, and T equations of state at each point along the Hugoniot curve.

MATHEMATICAL PHYSICS

40625 (K/CSD—5) Derivation of conservative finite difference expressions for the Navier—Stokes equations. Tunstall, J.N. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). Apr 1977. Contract W-7405-ENG-26. 43p. P 03/MF A01.

An analytical approach for obtaining conservative finite difference representations of the Navier—Stokes equations to be solved in a general two-dimensional region is presented. A particular case of this approach is used to derive the finite difference equations for a quadrilateral cell that have been reported in descriptions of Arbitrary-Lagrangian-Eulerian computing techniques. The simplified equations for a rectangular mesh are also obtained so that comparison with finite difference equations specifically derived for rectangular meshes can be made. 2 figures, 4 tables.

40626 (AD-A—027774) Algorithms for rational approximations for a confluent hypergeometric function. Luke, Y.L. (Missouri Univ., Kansas City (USA). Dept. of Mathematics). 1976. 35p. NTIS $4.00.

In the authors' volumes on the special functions, rational approximations for the confluent hypergeometric function (z/sup a/)U(a;c;z) were examined in some detail. This confluent function is very important in the applications since it includes as special cases the incomplete gamma function (special cases of which are exponential, sine and cosine integrals, Fresnel integrals and the error function), Bessel functions, parabolic cylinder functions and Coulomb wave functions. In the special case where a is unity, the confluent function becomes an incomplete gamma function. In this event, complete a priori error analyses for the main diagonal Pade approximations and much more were presented. For general parameters, the rational approximations treated were not of the Pade class. It was shown that the rational approximations converge, but a complete a priori analysis was not available. One of the purposes of this report is to correct this deficiency. FORTRAN programs are provided to evaluate the Pade and non-Pade rational approximations by using the appropriate recursion formulas to generate the numerator and denominator polynomials as a number, and to also evaluate the coefficients which define these polynomials. (GRA)

FUSION ENERGY

40627 Technology index for plasmaphysics research and fusion reactors. Volume 11, No. 3, 1977. Bibliography, author index, subject index, appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1977). 62p.

This bibliography contains 274 references on various aspects of controlled fusion research. Subject and author indexes are included. (MOW)

40628 Direct soft x-ray response of a charge-coupled image sensor. Koppel, L.N. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Rev. Sci. Instrum.;* **48**: No. 6, 669-672(Jun 1977).

To determine the feasibility of actively recovering data from x-ray imaging instruments used in the laser fusion program of Lawrence Livermore Laboratory, we have used a commercial, silicon video sensor to detect patterns of soft x rays (1—8 keV). The sensor is a two-dimensional, frame transfer, charge-coupled device (CCD), modified to allow direct access of x rays to the sensitive silicon. We discuss the x-ray sensitivity, linearity, and dynamic range of the CCD.

PLASMA RESEARCH

40629 Generation of a high-current, high-energy ion beam in a plasma by induced electric fields. Kolyada, Y.E.; Kornilov, E.A.; Fainberg, Y.B.; Kiyashko, V.A. (Khar'kov Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **2**: No. 10, 359-360(Oct 1976).

It is demonstrated experimentally that the application of an inhomogeneous magnetic field of 3 kG leads to a redistribution of the electric potential thus showing that a linear betatron may be employed to accelerate ion beams.(AIP)

PLASMA CONFINEMENT AND HEATING

40630 (PB—260555) **Study of fast magnetosonic wave and neutral beam heating of large tokamaks. Topical report.** Amherd, N.A.; Conn, R.W.; Kulcinski, G.L. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Sep 1976. 73p. Q 04/MF A01.

Studies of wave and neutral beam heating of tokamak plasma are presented. The leading wave heating candidates include low frequency Alfven waves, fast magnetosonic waves, lower hybrid waves, and electron cyclotron waves and these are briefly surveyed. A more detailed consideration is given to the fast magnetosonic wave and its use in heating a tokamak reactor to ignition. A conceptual magnetosonic wave launching system compatible with reactor plasmas is also described. The status of neutral beam heating, the requirements on injection energies, and the resulting heating profiles for reactor plasmas are described. Finally, a comparison of RF (radiofrequency) and neutral beam heating is presented. It is concluded that a high priority should be given to definitive high power RF tokamak heating experiments to clarify the physics base. A large effort on high energy neutral beam source development as is currently underway is also required.

40631 (ORNL-tr—4318) **Possibilities of heating a TFR plasma by absorption of the fast hydromagnetic wave.** Adam, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Oct 1973. Translation of EUR-CEA-FC—711. 12p. P 02/MF A01.

The prospects of TFR heating by fast hydromagnetic waves are considered by an examination of the following topics: (1) characteristics of the dispersion relation, (2) the charge impedance of an antenna capable of exciting these modes, and (3) the heating effects which would be caused by dissipation of these waves around $\omega = \omega/\text{sub ci}/$ and $\omega = 2\omega/\text{sub ci}/$. (MOW)

40632 Feasibility of using partially destructing solenoids for plasma confinement. Volkov, N.B.; Shneerson, G.A. (M. I. Kalinin Leningrad Polytechnical Institute). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **2**: No. 10, 353-354(Oct 1976).

Calculations are performed on the problem of the damage suffered by the solenoids when an ultrastrong magnetic field is used for plasma confinement in a thermonuclear reactor. Solenoids of lead, uranium, and lithium are considered.(AIP)

40633 Enhanced laser beam coupling to a plasma. Steiger, A.D.; Woods, C.H. (to Energy Research and Development Administration). US Patent 3,995,136. 30 Nov 1976. Filed date 18 Mar 1974. 6p. PAT-APPL-452,164.

Density perturbations are induced in a heated plasma by means of a pair of oppositely directed, polarized laser beams of the same frequency. The wavelength of the density perturbations is equal to one half the wavelength of the laser beams. A third laser beam is linearly polarized and directed at the perturbed plasma along a line that is perpendicular to the direction of the two opposed beams. The electric field of the third beam is oriented to lie in the plane containing the three beams. The frequency of the third beam is chosen to cause it to interact resonantly with the plasma density perturbations, thereby efficiently coupling the energy of the third beam to the plasma. 10 claims, 2 figures.

40634 Plasma control and utilization. Ensley, D.L. (to Energy Research and Development Administration). US Patent 4,000,036. 28 Dec 1976. Filed date 21 Jan 1971. 30p. PAT-APPL-108,521.

A plasma is confined and heated by a microwave field resonant in a cavity excited in a combination of the TE and TM modes while responding to the resonant frequency of the cavity as the plasma dimensions change to maintain operation at resonance. The microwave field is elliptically or circularly polarized as to prevent the electromagnetic confining field from going to zero. A high Q chamber having superconductive walls is employed to minimize wall losses while providing for extraction of thermonuclear energy produced by fusion of nuclei in the plasma. 24 claims, 15 figures.

40635 Mass scaling of permanent magnet line cusp plasma leaks. Christensen, T. (Univ. of Iowa, Iowa City); Hershkowitz, N.; Leung, K.N. *IEEE Trans. Plasma Sci.;* **PS-5**: No. 1, 23-26(Mar 1977).

Plasma leaks to permanent magnetic produced "full-line cusps" are shown to depend on ion mass as (m/sub i//sup ¼/). This result is consistent with hybrid gyroradius (i.e., geometric mean of ion and electron gyroradii) leaks but not with ion gyroradius leaks.

40636 End-loss processes from mirror machines. Baldwin, D.E. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Rev. Mod. Phys.;* **49**: No. 2, 317-339(Apr 1977).

The processes leading to end loss of ions from a mirror machine are reviewed. These include breakdown of adiabaticity, scattering and energy drag by classical collisions, and scattering by unstable fluctuations. Described are the linear theory of those modes thought to be of significance in present and reactor-size plasmas, and those features known of their nonlinear saturation.

40637 Efficient light absorption by ion-acoustic fluctuations in laser-produced plasmas. Manheimer, W.M.; Colombant, D.G.; Ripin, B.H. (Naval Research Laboratory, Washington, D.C. 20375). *Phys. Rev. Lett.;* **38**: No. 20, 1135-1138(16 May 1977).

We describe a new efficient absorption mechanism for intense laser light in plasma resulting from an ion acoustic instability generated by a return current. Comparisons with experimental results are presented.

40638 Long wavelength m=1 magnetohydrodynamics of a theta pinch. Miller, G. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Fluids;* **20**: No. 6, 928-935(Jun 1977).

The treatment of the magnetohydrodynamic problem of a sharp-boundary theta pinch plasma column in the presence of perturbing magnetic fields is extended to include long wavelength m=1 motion. The long wavelength m=1 instability, which is a serious problem for fusion devices based on the theta pinch, is explained in a simple way. Plasma equations of motion which are suitable for modeling of complicated experimental situations are given. The high-beta stellarator is discussed.

40639 Computer simulation of radio frequency confinement of a plasma near critical density. Gitomer, S.J.; Shohet, J.L. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Fluids;* **20**: No. 6, 1019-1024(Jun 1977).

The time evolution of an initially uniform slightly underdense (ω/sub e/approximately-less-thanω) plasma in a resonant cavity has been studied using two-dimensional electromagnetic simulations. The ponderomotive force compresses plasma into the nodes of the applied radio frequency field. The plasma buildup at the nodes terminates either when the plasma pressure increases to equal the field pressure or when phase space breaking occurs. Explanations of the density buildup and tail formation of the particle distribution functions are provided.

PLASMA DIAGNOSTICS

REFER ALSO TO CITATION(S) 40042

40640 Heterodyne detection of pulsed CO_2 laser light scattered from ion acoustic waves in a plasma. Baker, D.R.; Heckenberg, N.R.; Meyer, J. (Max-Planck-Institut fuer Plasmaphysik, Munich). *IEEE Trans. Plasma Sci.;* **PS-5**: No. 1, 27-30(Mar 1977).

The small angle scattering of light from a pulsed CO_2 laser has been used to measure ion acoustic waves excited in a low density plasma. The laser is a hybrid laser consisting of a high pressure TEA discharge and a low pressure continuous discharge. The scattered light is detected by heterodyning, using laser light as the local oscillator. Two methods of providing the laser light local oscillator have been used. The dependence of the scattered light on the ion acoustic wavelength has been measured. The amplitude of the scattered light compared with the amplitude of the waves in the plasma indicates that the heterodyne mixing efficiency is better than 10 percent.

40641 Molecular-beam sampling of a hollow-cathode discharge in argon as a plasma diagnostic and a source for fast neutrals. Theuws, P.G.A.; Beijerinck, H.C.W.; Schram, D.C.; Verster, N.F. (Physics Department, Eindhoven University of Technology, Eindhoven, The Netherlands). *J. Appl. Phys.;* **48**: No. 6, 2261-2269(Jun 1977).

Velocity analysis of the molecular beam is done with a time-of-flight method. The measured velocity distribution of the fast neutral atoms is described by the sum of two Maxwell-Boltzmann distributions with temperatures on the order of 0.25 and 1 eV, respectively. This bimodal distribution is attributed to an overpopulation of the high-energy tail of the ion velocity distribution. The measured intensities of the fast neutrals vary between 5×10^{14} and 7×10^{15} (molecules $s^{-1} sr^{-1}$).

40642 Expansion of the spontaneous magnetic field in a plasma produced on a copper target by a CO_2 laser. Drouet, M.G.; Bolton,

R.; Kieffer, P.; Saint-Hilaire, G.; Szili, Z.; Pepin, H.; Grek, B. (Direction Sciences de base, Institut de recherche de l'Hydro-Quebec, Varennes, Quebec, Canada JOL 2PO). *J. Appl. Phys.;* **48**: No. 6, 2525-2530(Jun 1977).

Measurements are presented for the magnetic field B and the uv radiation generated by a plasma produced by irradiation of a copper target by a 4-J 1.7-ns CO_2 laser. The dependences of the uv and B intensities on the N_2 or the helium background pressure are found to be comparable. There are two phases in the field expansion: diffusion within the photoionized background followed by convection with the laser plasma.

40643 Spectroscopic observation of fast ions from laser-produced plasmas. McLean, E.A.; Decoste, R.; Ripin, B.H.; Stamper, J.A.; Griem, H.R.; McMahon, J.M.; Bodner, S.E. (Naval Research Laboratory, Washington, D. C. 20375). *Appl. Phys. Lett.;* **31**: No. 1, 9-11(1 Jul 1977).

Using a time-of-flight spectroscopic technique, measurements were made of the ion energy distributions of very fast ions and thermal ions produced when a 7—15-J 100-psec Nd : glass laser pulse (1.06 μm) strikes a (CH_2)/sub n/ slab target. Ion energies greater than 0.5 MeV have been observed for the first time with this technique of measurement. A simultaneous comparison is made between the signal of an ion charge collector placed 30 cm from the target and the intensity of the C VI 3434-A ion line at 1 cm from the target.

PLASMA KINETICS - GENERAL

REFER ALSO TO CITATION(S) 40529, 40538

PLASMA KINETICS - THEORETICAL

40644 (COO—2456-40) **High-beta plasma research. Progress report, February 1976—February 1977.** Chu, C.K.; Gross, R.A. (Columbia Univ., New York (USA). Plasma Physics Research Lab.). Feb 1977. Contract EY-76-S-02-2456. 73p. Dep. NTIS $4.50.

Separate abstracts were prepared for each of the 3 included sections. (MOW)

40645 (COO—2456-40, pp 66-74) **Theory and computing research.** Chu, C.K.; Lui, H.C.; Reusch, M.; Wakatani, M.; Park, W.; Sharky, N.; Aydemir, A.; Rivier, M. Feb 1977.

In High-beta plasma research. Progress report, February 1976—February 1977.

Initial value toroidal plasma dynamics and implosion calculations have been developed which can now run all the way to equilibrium. Screw pinches and reversed field pinches with anomalous dissipation have been simulated. A two-dimensional linear and a three-dimensional nonlinear stability code were used. Theoretical studies of high-beta toroidal transport were also started.

40646 Theory of turbulent plasma. Tsytovich, V.N. New York; Consultants Bureau (1977). 540p.

Translated from Russian by D.L. Burdick.

Important topics covered in the book include the following: (1) collective dissipation and excitation of turbulent fluctuations, (2) the spectra of stationary plasma turbulence, (3) stochastic particle acceleration in turbulent plasma, (4) radiation from a turbulent plasma, (5) passage of electromagnetic waves through turbulent plasma, and (6) electromagnetic properties of turbulent plasma. (MOW)

40647 Ion current reduction in pinched electron beam diodes. Quintenz, J.P.; Poukey, J.W. (Plasma Theory Division : 5241, Sandia Laboratories, Albuquerque, New Mexico 87115). *J. Appl. Phys.;* **48**: No. 6, 2287-2293(Jun 1977).

A new version of a particle-in-cell diode code has been written which permits the accurate treatment of higher-current diodes with greater physical dimensions. Using this code, we have studied ways to reduce the ion current in large-aspect-ratio pinched electron beam diodes. In particular, we find that allowing the ions to reflex in such diodes lowers the ion to electron current ratio considerably. In a 3-MV R/d=24 case this ratio was lowered by a factor of 6—8 compared with the corresponding nonreflexing-ion diode, while still producing a superpinched electron beam.

40648 Plasma effects on the spontaneous emission of synchrotron radiation from weakly relativistic electrons. Freund, H.P.; Wu, C.S. (Institute for Physical Science and Technology, University of Maryland, College Park, Maryland 20742). *Phys. Fluids;* **20**: No. 6, 963-973(Jun 1977).

A method for computing the spectral emissivity of spontaneous synchrotron radiation is discussed. The Klimontovich formalism in plasma kinetic theory is adopted in which an ensemble average of the microscopically emitted power is considered. The present method clarifies the meaning of the random phase approximation which is imposed in several existing theories of synchrotron radiation. Both the effects of dielectric polarization and two-particle correlations are included in the present discussion. The theory is applied to the case of a plasma in thermal equilibrium, for which it is shown that the effect of pair correlations on the emissivity vanishes. On the other hand, the effect of dielectric polarization is studied numerically for a wide range of parameters.

PLASMA PRODUCTION

40649 Surface pressures from laser-supported detonations. Holmes, B.S.; Erlich, D.C. (Stanford Research Institute, Menlo Park, California 94025). *J. Appl. Phys.;* **48**: No. 6, 2396-2403(Jun 1977).

The surface pressures directly behind a Laser-Supported Detonation (LSD) were measured with a system of carbon piezoresistive gauges. A quartz piezoelectric gauge was also used to measure surface pressures far away from the laser spot. The small size of the carbon gauges, relative to the laser beam diameter, permitted simultaneous resolution of the surface pressure history at several locations within the laser spot. A comparison of the experimental data with recent theories indicates that the theories predict peak pressures close to those measured but overestimate the impulse intensity at the target surface.

PLASMA INSTABILITIES

40650 (COO—2714-2) **New formalism for microinstabilities in the Tormac sheath regime.** Bakshi, P. (Boston Coll., Chestnut Hill, Mass. (USA). Dept. of Physics). Aug 1976. Contract EY-76-S-02-2714. 13p. P 02/MF A01.

A new formalism has been developed for the treatment of microinstabilities in complex magnetic field geometries. This is illustrated through the problem of shear stabilization of drift waves. Earlier theories appear as special limiting cases, and the need for the extended theory for the correct description of strong shear and strong density gradient regimes such as the Tormac sheath is pointed out.

40651 (PPPL—1338) **Drift-tearing instabilities due to trapped electrons.** Chen, L.; Rutherford, P.H.; Tang, W.M. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Mar 1977. Contract EY-76-C-02-3073. 16p. P 02/MF A01.

It is shown that the collisional detrapping of magnetically trapped electrons in tokamaks can excite drift-tearing modes with high azimuthal mode numbers. For normal temperature gradients (d ln T/sub e//d ln n greater than 0), the modes are unstable in the collisional regime (ν/sub eff/ greater than ω/sub *e/), but stable in the collisionless regime (ν/sub eff/less than ω/sub *e/).

40652 (ORNL-tr—4329) **Development of internal MHD-oscillations in the Tokamak-4 device.** Berlizov, A.B.; Mirnov, S.V.; Notkin, G.E.; Semenov, I.B.; Smit, R.; Shcheglov, D.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1976. Translation by S.D. Blalock Jr. of IAE—2742. 30p. P 03/MF A01.

The development of MHD-perturbations was investigated by the aid of a multichannel system of soft x-ray emission sensors mounted in three cross-sections of the T-4 tokamak and a system of internal magnetic probes. Such a system of sensors made it possible to trace the correlation between internal and external perturbations of the plasma column.

40653 Fast electrons in magnetized plasma subjected to intense radiation. Aleksandrov, V.V.; Bychenkov, V.Y.; Litvin, S.B.; Pustovalov, V.V.; Silin, V.P.; Tikhonchuk, V.T. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **2**: No. 10, 340-341(Oct 1976).

Instability growth rates are calculated for the parametric instability of a slow magnetosonic wave in a magnetized plasma. Both nonlinear and quasilinear effect are considered.(AIP)

40654 Nonlinear saturation of the collisionless drift instability. Simon, A.; Gross, L.S. (Department of Mechanical and Aerospace Sciences, University of Rochester, Rochester, New York 14627). *Phys. Fluids;* **20**: No. 6, 946-959(Jun 1977).

A collisionless spatially nonuniform plasma is considered in a finite conducting cylinder in a uniform magnetic field. The magnetic field is increased by a small fractional amount over the critical value for onset of instability. A single mode grows and is saturated by nonlinear effects. Analytic expressions are obtained for the time-asymptotic saturation amplitude and frequency shift. Indeterminate equations and singular functions are resolved by methods similar to those used earlier in the one-dimensional bump-on-tail analysis, and the form of the modified equilibrium distribution and potential is obtained. A specific numerical example demonstrates that saturation is due to increased ion Landau damping, and that this saturated amplitude is unstable to small deviations. Hence, the onset of the instability is predicted to be of the "hard" variety. This result holds both in the "quasi-linear" approximation and in the full nonlinear case.

40655 Electron stabilization of drift-cone modes. Aamodt, R.E. (Science Applications, Inc., Boulder, Colorado 80302). *Phys. Fluids;* **20**: No. 6, 960-962(Jun 1977).

The mechanism of electron trapping in E x B guiding center motion is proposed as the mechanism for absolute stabilization of drift-cone modes in mirror geometry. The calculated amplitudes are shown to be in reasonable agreement with experimental results in present mirror machines.

40656 Observed instabilities in the trapped ion regime in the levitated octupole. Drake, J.R. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). *Phys. Fluids;* **20**: No. 6, 1013-1018(Jun 1977).

Two unstable modes were observed in the average minimum-B region of the levitated octupole operating with a weak toroidal field (safety factor of approximately 0.25) and collisionless ions. One mode propagated in the electron diamagnetic drift direction and the other mode propagated in the ion diamagnetic drift direction. The frequencies of the modes were much greater than the ion detrapping collision frequency and slightly less than the trapped ion bounce frequency. The electron collisionality was intermediate between the collisionless trapped ion mode and the dissipative trapped ion mode regimes. Density fluctuation levels from 5% to 50% and enhanced transport approaching Bohm diffusion were the manifest effects of the instabilities. When the ion collisionality was increased by cooling the ion temperature, the unstable fluctuations were not seen.

40657 Oscillating beam-plasma instabilities excited by single and counterstreaming beams. Jones, R. (8926 Libra Dr., San Diego, California 92126). *Phys. Fluids;* **20**: No. 6, 1029-1030(Jun 1977).

Oscillating beam-plasma instabilities are created by applying feedback to amplifying (convective) modes. A simple theory of such instabilities is presented and compared with experiments employing one and two (counterstreaming) beams.

40658 Shear stabilization of the purely growing trapped particle instability. El-Nadi, A. (Institut fuer Plasmaphysik der Kernforschungsanlage Juelich GmbH, 517 Juelich, Federal Republic of Germany). *Phys. Fluids;* **20**: No. 6, 1032-1034(Jun 1977).

The collisionless trapped particle instability in toroidal systems is studied as a radial boundary value problem. It is shown that in the presence of a small amount of magnetic shear, electrons can flow along the field lines to stabilize the mode.

PLASMA WAVE PHENOMENA

40659 Excitation of potential surface oscillations of a plasma by a tubular electron beam. Ivanov, S.T. *Bulg. J. Phys.;* **2**: No. 6, 632-639(1975). (In Russian).

By using the conventional equation for the potential of small perturbations that depend on time and coordinates as f(r)exp(-iwt + il phi + ik/sub z/z) a dispersion equation is derived for longitudinal potential waves induced by a tubular non-relativistic electron beam with thin walls in a longitudinal magnetic field in a plasma with the same configuration and dimensions bounded by a vacuum. Only the case of rf oscillations is considered. Cases of development of beam and cyclotron instabilities are considered for long-wave and short-wave surface waves that can be induced only in an unmagnetized plasma (the long-wave oscillations—in a rarefied plasma, and the short-wave oscillations—in a dense plasma). The relation between increments of beam and cyclotron instabilities is discussed. The maximum amplitude of a steady-state monochromatic wave is estimated.

40660 Interaction of a high-current electron beam with a plasma in open cavity in a mirror system. Kolyada, Y.E.; Fainberg, Y.B.; Kornilov, E.A.; Ognivenko, V.V.; Kiyashko, V.A. (Khar'kov Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **2**: No. 10, 348-350(Oct 1976).

A 12-kA electron beam of energy 150 keV and pulse length 0.7 μsec was injected into a glass chamber in a magnetic mirror field. Inside the chamber was an open cavity, and the emitted microwave power spectra was investigated.(AIP)

40661 Natural oscillations of a bounded volume of magnetized cold plasma. Krylov, A.L.; Fedorov, E.N. (O. Yu. Shmidt Earth Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. Phys. - Dokl. (Engl. Transl.);* **21**: No. 11, 630-631(Nov 1976).

Using the magnetized cold plasma model for the Earth's magnetosphere, the Maxwell equations are solved for the case of magnetohydrodynamic oscillations.(AIP)

40662 Modification of a magnetic field by plasma mechanisms. Vainshtein, S.I. (Siberian Institute of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation, Siberian Division, USSR Academy of Sciences, Irkutsk). *Sov. Phys. - Usp. (Engl. Transl.);* **19**: No. 12, 987-1006(Dec 1976).

The review is devoted to the question of the rapid modification (generation, damping, etc.) of a magnetic field in a collision-dominated plasma, when the frequency γ of the process is lower than the electron-collision frequency ν. The universally employed approach: the dynamo theory: is discussed in Chap. 2. The simplest motions that lead to generation, to rapid annihilation of the "antidynamo", and to a modification of the topological-pumping type are indicated. The discussion concerns problems of the turbulent dynamos (where a functional approach is used) and of the nonlinear dynamo. In the latter case, the Gibbs ensemble is used; a reverse cascade of magnetic and kinetic energy into the region of small wave numbers is observed. Other plasma mechanisms are discussed, namely the modification of the field by ion sound, the weakly-ionized plasma, and the solid-state plasma (dynamo based on thermal effects) : Chap. 3. It is shown that the modification can be quite effective. Discussed in Chap. 4 are high-frequency oscillations (whistlers, Langmuir oscillations) and their role in the modification of the field. The indicated mechanisms can be effective under conditions of the solar chromosphere.

40663 Effects of frequency averaging on estimates of plasma wave coherence spectra. Kim, Y.C.; Powers, E.J. (Univ. of Texas, Austin). *IEEE Trans. Plasma Sci.;* **PS-5**: No. 1, 31-40(Mar 1977).

The effects of frequency averaging (i.e., data smoothing) on digitally computed plasma-wave coherence-spectra are investigated. Such averaging, or smoothing, of the data is necessary to reduce the variance of the spectral estimators to acceptable levels. However, too much averaging results in a loss of frequency resolution and in an "artificial" reduction of the degree of coherence characterizing each wave in the fluctuation spectrum. This latter problem is the subject of this paper and it is concluded that in order to avoid such difficulties, it is necessary: (1) that the averaging bandwidth be small compared to the spectral bandwidth of the wave packet, and (2) that the distance between the two spatial monitoring points be small compared to the coherence length of the wave packet.

40664 Transverse flux constraint for excitation of electron plasma waves in a magnetic field. Willett, J.E.; Maraghechi, B. (Department of Physics, University of Missouri-Columbia, Columbia, Missouri 65201). *J. Appl. Phys.;* **48**: No. 6, 2644-2645(Jun 1977).

The analog of the conservation law for photon number is derived for a three-wave interaction involving two circularly polarized electromagnetic waves and an electron plasma wave propagating along a uniform static magnetic field.

40665 Numerical study of two-dimensional generation and collapse of Langmuir solitons. Pereira, N.R.; Sudan, R.N.; Denavit, J. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14853). *Phys. Fluids;* **20**: No. 6, 936-945(Jun 1977).

Numerical studies of various aspects of two-dimensional Langmuir solitons, are made, viz., (i) instability and collapse of a planar soliton perturbed in the perpendicular direction, (ii) the effect of an approximate Landau damping on the collapse, and (iii) the generation and subsequent collapse of planar solitons by an external pump field. These computations verify the flow of energy from long wavelength pump fields, through soliton formation and collapse, to shorter wavelengths, where the energy is transferred to the electrons.

40666 Linear wave conversion in an unmagnetized, collisionless plasma. Speziale, T.; Catto, P.J. (Department of Mechanical and Aerospace Sciences and Laboratory for Laser Energetics, University of Rochester, Rochester, New York 14627). *Phys. Fluids;* **20**: No. 6, 990-997(Jun 1977).

Analytic solutions to the problem of linear wave conversion in a cold, unmagnetized, collisionless plasma are obtained for nearly all angles of incidence. The resulting absorption coefficients are in excellent agreement with numerical work in the appropriate limits and differences in previous solutions are reconciled. The warm plasma equations are also solved, and the independence of the absorption coefficient to thermal effects verified. The singularities neglected by Piliya are properly treated by viewing the frequency dependence as arising from a Laplace transform.

40667 Velocity shear instability of Alfven waves in a high β collisionless plasma. Dobrowolny, M. (Laboratorio Plasma Spazio, Consiglio Nazionale delle Ricerche, Frascati, Italy). *Phys. Fluids;* **20**: No. 6, 1027-1028(Jun 1977).

An instability of Alfven waves driven by parallel velocity shear has been derived for a high β collisionless plasma. The unstable waves propagate in a narrow cone around the magnetic field.

40668 Plasma wave instability in the field of an intense electromagnetic wave. Amato, M.A.; Miranda, L.C.M. (Departamento de Fisica, Universidade de Brasilia, 70.000 Brasilia, DF, Brasil). *Phys. Fluids;* **20**: No. 6, 1031-1032(Jun 1977).

The plasmon scattering by electrons in the presence of an intense laser field is discussed. It is shown that in the strong field limit the plasmon population may become unstable.

FUSION POWER PLANTS

REFER ALSO TO CITATION(S) 39451

40669 (BNWL—1939-6) **Pacific Northwest Laboratory report on fusion energy research, October 1976—December 1976.** (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1977. Contract EY-76-C-06-1830. 47p. P 03/MF A01.

Separate abstracts were prepared for three of the included sections. (MOW)

40670 (COO—2456-40, pp 29-65) **High-beta toroidal experimental research.** Gross, R.A.; Marshall, T.C.; Lidofskii, L.; Sandel, F.; Weber, P.; Graupner, R.; Georgiou, G.; Barbee, S.; Marsen, J.; Paul, S. Feb 1977.

In High-beta plasma research. Progress report, February 1976—February 1977.

Experimental results and operating characteristics obtained during this past year from Torus I are presented. Columbia Torus II, a hot, high-beta tokamak research machine, has been designed, is being constructed, and is briefly described. The computer data acquisition system to be employed with Torus II is also described.

40671 (ERDA—77-36) **Second workshop on conceptual design studies of Experimental Power Reactor-1, Madison, Wisconsin, November 4—5, 1976.** Murphy, M. (ed.). (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Magnetic Fusion Energy). Mar 1977. 68p. P 04/MF A01.

This workshop was organized to provide an independent assessment of the ANL, GA, and ORNL design by other members of the fusion community. Cochairmen were carefully selected for their expertise and experience in a particular subject matter. The session reports which comprise this document, summarize the review of the designs by the cochairmen based on their own expertise and judgment. The following sessions are included: (1) toroidal coils, (2) first wall, blanket, and shield, (3) tritium systems, (4) initial assembly, maintenance in a radiation environment, (5) plasma physics, (6) poloidal coils, (7) project engineering, BOP, cost, and scheduling, and (8) plasma support systems. (MOW)

40672 (PB—260653) **Enhanced energy utilization from a controlled thermonuclear fusion reactor. Final report.** Scott, F.R. (Fusion Systems Corp., Rockville, Md. (USA)). Sep 1976. 112p. Q 06/MF A01.

Applications of the unique forms of fusion energy to synthetic fuel production, chemical manufacturing, and materials processing have been studied. Computer codes were developed to permit quantitative calculation of the enhancement of energy utilization efficiency for multipurpose Tokamak and Mirror reactors. Production of synthetic portable fuels such as hydrogen or methane by neutron radiolysis is identified as the most important near term application. Fuel production offers large advantages for low Q, high circulating power systems such as mirrors, small Tokamaks, theta pinches, and laser pellet reactors. It offers little advantage to high Q, high thermal efficiency systems typified by large Tokamaks. General descriptions are given of the unique energy forms of a fusion reactor as well as the many processes that these energy forms could promote.

40673 (TID—27494) **Physics studies for TFTR.** (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Feb 1977. Contract EY-76-C-02-3073. 91p. P 05/MF A01.

This report is divided into the following sections: (1) system capability, (2) simulation of high current discharges, (3) neutral injection heating studies, and (4) TFTR diagnostic system. (MOW)

40674 (UCID—17397) **Fusion—fission hybrid reactors: a capsule introduction.** Holdren, J.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Feb 1977. Contract W-7405-ENG-48. 11p. Dep. NTIS $3.50.

A short introduction to fusion-fission hybrid systems is provided touching on (a) basic technological characteristics; (b) potential applications; (c) relevance of environmental considerations in the development rationale for hybrids. References to the more technical literature are supplied.

40675 **Conceptual design of a 20 Tesla pulsed solenoid for a laser solenoid fusion reactor.** Nolan, J.J.; Averill, R.J. (Magnetic Engineering Associates, Inc., Cambridge, MA). *IEEE Trans. Plasma Sci.;* **PS-5**: No. 1, 7-11(Mar 1977).

Design considerations are described for a strip wound solenoid which is pulsed to 20 tesla while immersed in a 20 tesla bias field so as to achieve within the bore of the pulsed solenoid at net field sequence starting at 20 tesla and going first down to zero, then up to 40 tesla, and finally back to 20 tesla in a period of about 5 x 10^{-3} seconds. The important parameters of the solenoid, e.g., aperture, build, turns, stored and dissipated energy, field intensity and powering circuit, are given. A numerical example for a specific design is presented. Mechanical stresses in the solenoid and the subsequent choice of materials for coil construction are discussed. Although several possible design difficulties are not discussed in this preliminary report of a conceptual magnet design, such as uniformity of field, long-term stability of insulation under neutron bombardment and choice of structural materials of appropriate tensile strength and elasticity to withstand magnetic forces developed, these questions are addressed in detail in the complete design report and in part in reference one. Furthermore, the authors feel that the problems encountered in this conceptual design are surmountable and are not a hindrance to the construction of such a magnet system.

PHYSICS AND BLANKET ENGINEERING

REFER ALSO TO CITATION(S) 40673

40676 (BNWL—1939-6, pp 3-18) **Fusion systems engineering.** Jan 1977.

In Pacific Northwest Laboratory report on fusion energy research, October 1976—December 1976.

In cooperation with the University of Wisconsin PNL is defining and evaluating a fissile breeding outside blanket for the Tokamak Engineering Test Reactor (TETR) based upon near-term technological developments that could be implemented in the middle or late 1980's. With these constraints, uranium dioxide (UO_2) has been identified as the fertile breeding material for production of plutonium, and the capability of a conceptual, UO_2-fueled, outer blanket to produce power, plutonium, and tritium has been determined. Plutonium production rates and tritium breeding performance were also assessed in calculations using the conceptual TETR hybrid blanket with various technologically advanced fuels-UMo, UC, and U_3Si.

MAGNET COILS AND FIELDS

40677 (ORNL/TM—5262) **User's manual for the Oak Ridge Tokamak Transport Code.** Munro, J.K.; Hogan, J.T.; Howe, H.C.; Arnurius, D.E. (Oak Ridge National Lab., Tenn. (USA)). Feb 1977. Contract W-7405-ENG-48. 309p. Dep. NTIS $10.00.

A one-dimensional tokamak transport code is described which simulates a plasma discharge using a fluid model which includes power balances for electrons and ions, conservation of mass, and Maxwell's equations. The modular structure of the code allows a user to add models of various physical processes which can modify the discharge behavior. Such physical processes treated in the version of the code described here include effects of plasma transport, neutral gas transport, impurity diffusion, and neutral beam injection. Each process can be modeled by a parameterized analytic formula or at least one detailed numerical calculation. The program logic of each module is presented, followed by detailed descriptions of each subroutine used by the module. The physics underlying the models is only briefly summarized. The transport code was written in IBM FORTRAN-IV and implemented on IBM 360/370 series computers at the Oak Ridge National Laboratory and on the CDC 7600 computers of the Magnetic Fusion Energy (MFE) Computing Center of the Lawrence Livermore Laboratory. A listing of the current reference version is provided on accompanying microfiche.

40678 **Interaction and protection of superconducting poloidal field coils and toroidal field coils in a tokamak Experimental Power Reactor.** Yeh, H.T.; Lue, J.W. (Oak Ridge National Lab., TN). *Nucl. Technol.;* **33**: No. 2, 151-160(Apr 1977).

The protection problems of superconducting coils in a large tokamak device are delineated. Effects of the plasma discharge on the first wall, the induced voltage, and the temperature rise during the quench of a superconducting coil, as well as the mechanical load on coils due to their mutual interaction under normal or fault conditions, have been studied. Various design choices and protection schemes are used to ensure the integrity of the coils during quench. For the Oak Ridge Experimental Power Reactor design, a scheme of connecting symmetrically located toroidal field coils in groups isolates and discharges the fault coil only, giving satisfactory results.

POWER SUPPLIES AND CIRCUITRY

40679 (N—76-27478) **Control of the spark gap switch by radiation.** Noguchi, T. (Electrotechnical Lab., Tokyo (Japan)). Nov 1976. 108p. (REPT—756). NTIS $5.50.

There is an urgent need to develop high-speed switches with high reliability in various fields, for example in nuclear fusion and high energy physical experiments. The spark gap is a high-power and high-speed switch. An outstanding advantage of the spark gap switch controlled by irradiation is that the controlling electronics are completely isolated from the switch. Systematical investigation into control of the gap switch by irradiation is presented.

40680 (UCRL-Trans—11226) **High speed foil breakers.** Andrezen, A.B.; Burtsev, V.A.; Vodovozov, V.M.; Dubanskii, V.A.; Egorov, N.P.; Litunovskii, V.N.; Ovsannikov, V.A.; Produvnov,

A.B.; Prokopenko, V.F.; Shestakov, I.V. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). Mar 1977. Translation of NIIEFA Preprint K-0292. 25p. P 02/MF A01.

The results are presented of an experimental investigation of the electric explosion of aluminum foil in different arc-quenching media, and of a study of the operating characteristics of foil circuit-breakers and of their practical use in a high-speed theta-pinch power-supply system.

40681 (UCRL-Trans—11227) **Study of electric explosion of cylindrical foils in air.** Burtsev, V.A.; Dubanskii, V.A.; Kasatkina, M.P.; Produvnov, A.B.; Shestakov, I.V. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). Mar 1977. Translation of NIIEFA Preprint K-0293. 33p. P 03/MF A01.

The results are described of an experimental investigation of the characteristics of an electric explosion of cylindrical foil in air, and of the properties of the electric-discharge plasma of a heavy-current discharge. The unusually large energy expenditure in explosions of flat foil at high current densities, and the incomplete vaporization of the metal at lower densities, both observed earlier, are confirmed. A study is made of the radiation characteristics of a heavy-current discharge in air and in metal vapors. An effect is noted involving a sharpening of the light pulse of an electric-discharge plasma having the character of a continuous emitter.

FUEL SYSTEMS

REFER ALSO TO CITATION(S) 39361, 39362, 39363

40682 (EPRI-ER—388) **Considerations on a tritium reprocessing system utilizing solid tritium getters in a lithium cooled thermonuclear reactor.** Yakura, J.S. (California Univ., Los Angeles (USA). Dept. of Energy and Kinetics). Mar 1977. 109p. P 06/MF A01.

The tritium reprocessing system which utilizes a solid tritium-ritium getter in the lithium cooled CTR has been investigated. Kinetic considerations of the solid tritium getter with particular emphasis on the yttrium metal are examined in detail. Since the startup tritium inventory is known to depend significantly on the tritium reprocessing time, a detailed evaluation of this system in terms of a dynamic model is used to determine the tritium transfer rate and the associated tritium inventory. Properties and behaviors of aging yttrium tritide have been looked into to determine the effects of prolonged use of this metal. Considerations of imperfect drainage of lithium and consequent formation of lithium tritide have been considered during the reprocessing stage. Since the impurity coatings of stable yttrium compounds, especially the oxide coating, may impede the transfer rate, numerous metal impurity getters are selected for simultaneous removal of impurities present in lithium.

40683 (UCID—17424) **Differencing of the diffusion equation in LASNEX.** Kershaw, D.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Mar 1977. Contract W-7405-ENG-48. 30p. P 03/MF A01.

The general problem of finite differencing of the diffusion equation on a two dimensional Lagrangian hydrodynamic mesh is discussed and a detailed description is given of the manner in which the diffusion equation is differenced in the Laser Fusion Code LASNEX.

40684 **Apparatus for producing uniform solid spheres of hydrogen.** Foster, C.A.; Kim, K.; Turnbull, R.J.; Hendricks, C.D. (Department of Electrical Engineering, University of Illinois, Urbana, Illinois 61801). *Rev. Sci. Instrum.;* **48**: No. 6, 625-631(Jun 1977).

An apparatus has been constructed which produces uniform spheres of solid hydrogen for experiments testing the feasibility of using the solid hydrogen pellets for refueling fusion reactors. Two versions of the apparatus were developed, one which produced 70-μm-diam pellets at the rate of 10^5/sec and another which produced 210-μm pellets at the rate of 2.6×10^4/sec. The first step in the pellet production is to liquefy the hydrogen by flowing it through a liquid-helium-cooled heat exchanger. Then, a liquid hydrogen jet is formed by flowing the hydrogen through a nozzle. The jet is broken up into uniform drops by an acoustical excitation. The drops are frozen by evaporation in a pressure less than the triple point pressure of hydrogen. Finally, the drops are injected into vacuum for the experiments.

40685 **Ionizer for cluster ion accelerators.** Henkes, W.; Hoffman, V.; Mikosch, F. (Institut fuer Kernverfahrenstechnik, Kernforschungszentrum Karlsruhe, Postfach 3640, D-7500 Karlsruhe 1, Germany). *Rev. Sci. Instrum.;* **48**: No. 6, 675-681(Jun 1977).

The design and performance of a cluster ionizer of the Bayard—Alpert type which is intended to be used in cluster accelerators is described. Positive cluster ions are formed from neutral hydrogen clusters with an efficiency of up to 80%. The mean size of clusters can be reduced by an order of magnitude by multiple ionization followed by splitting into charged fragments due to the repulsion between the individual charges. The fraction of the electrical current carried by cluster ions exceeds 90% of the total ion current. At low particle density two modes of operation are found. The "normal" mode A with high efficiency is characterized by space charge compensation of the primary electrons. In mode B this compensation is missing and the efficiency drops to less than 20% of that of mode A.

40686 **The implosion of cryogenic spherical shell targets.** Henderson, T.M.; Johnson, R.R. (KMS Fusion, Inc., Ann Arbor, Michigan 48106). *Appl. Phys. Lett.;* **31**: No. 1, 18-20(1 Jul 1977).

Spherical glass shells filled with deuterium-tritium gas have been used as cryogenic targets in neutron-producing experiments. Experiments were performed under cryogenic conditions to determine the state and form of the fuel at the time of arrival of the laser pulse in target interaction experiments. The results from neutron-producing experiments indicate that cryogenic targets implode significantly better than room-temperature targets under comparable experimental conditions and that the neutron production for cryogenic targets is significantly greater than for equivalent targets at room temperature.

RADIATION HAZARDS

40687 (BNWL—1939-6, pp 33-39) **Safety analysis and environmental effects of fusion concepts.** Jan 1977.

In Pacific Northwest Laboratory report on fusion energy research, October 1976—December 1976.

PNL has begun an effort this fiscal year to define the scope of a fusion reactor safety program plan and to identify the basic technology necessary to prepare a comprehensive safety analysis report on a fusion power plant. Formulation of the plan emphasizes planning and implementation activities and the identification of safety criteria applicable to fusion reactors. This quarter, contacts were initiated with other laboratories engaged in fission safety research and an investigation was started to examine the relevance of existing fission reactor safety criteria to the fusion program.

40688 (PB—260562) **Tritium inventory considerations in fusion reactors. Topical report.** Sehnert, M.J.; Amherd, N. (California Univ., Los Angeles (USA). Dept. of Energy and Kinetics). Oct 1976. 84p. Q 05/MF A01.

The feasibility of controlled thermonuclear fusion has yet to be proven. However, early attempts at a safety analysis of proposed plant designs can point out possible accident situations which can then be considered in future development programs. Tritium which will be present in early concern with regard to the exposure of the public to a radioactive material. Before any attempt can be made to ascertain the danger to the public of either steady state releases of tritium to the environment or of releases associated with a plant accident, it is necessary to determine the magnitude of the tritium inventory. This work presents a model which will allow for the determination of this inventory based on system operating parameters. A parametric study is also presented to show how system residence times and reactor operating parameters effect the plant inventory.

40689 (ERDA-tr—267) **Comparison of the radiation hazard of fission and fusion reactors.** Sivintsev, Yu.V. Translated from *At. Energ. (USSR);* **39**: No. 3, 173-176(1975). 7p. P 02/MF A01.

An earlier paper (Hafele, W. and C. Starr, J. Brit. Nucl. Energy Soc., Vol. 13, No. 2, 1974, p. 131) on the hazards of fission and fusion reactors examined only the exposure of the population during emergency situations and as a result of waste removal. This paper claims a more detailed analysis than the earlier paper. More radioisotopes are considered in this study. (MOW)

40690 (PB—255502) **Environmental and safety aspects of alternative nuclear power technologies - fusion power systems.** Mann, B.J. (Environmental Protection Agency, Las Vegas, Nev. (USA). Office of Radiation Programs). May 1976. 56p. (ORP/LV—76-7). NTIS $4.50.

An examination of environmental and safety issues associated with advanced nuclear power technologies is being conducted by the EPA Office of Radiation Programs. Part of this effort has been devoted to a review of fusion power systems. In the past several years, progress in fusion power research and development has led to the production of conceptual power plant designs for several fusion concepts. These have included both magnetic and inertial (primarily laser fusion) confinement systems. One of the more promising concepts is the tokamak magnetic confinement scheme, and several fairly detailed power plant designs based on this concept have been produced. The tokamak designs prepared by the Princeton and Wisconsin fusion power plant design groups were used as the basis for the present review. The present discussion includes a review of the main features of tokamak power plants with emphasis on radiological aspects. Both inplant and environmental health physics implications of the designs are briefly reviewed. Environmental control and radioactive waste management considerations are included.

POWER CONVERSION SYSTEMS

40691 **Direct convertor based upon space charge effects.** Gitomer, S.J. (Los Alamos Scientific Lab., NM). *iEEE Trans. Plasma Sci.;* **PS-5**: No. 1, 18-22(Mar 1977).

A device capable of converting directly the kinetic energy of charged particles into electrical energy is considered. The device differs from earlier ones (such as Post's periodic focus electrostatic direct convertor) in that it makes use of the space charge repulsion in a high density charged particle beam. The beam is directed into a monotonic decelerating electrostatic field of a several-stage planar-finned structure. The collector fins coincide with vacuum equipotential surfaces. Space charge blowup of the beam directs particles onto various collector fins. The energy efficiency of a 4-stage device has been determined using a numberical simulation approach. We find that efficiencies approaching 75 percent are possible. An approximate scaling law is derived for the space charge based direct converter and a comparison is made to the periodic focus direct convertor. We find the space charge based direct convertor to be superior to a number of ways.

INERTIAL CONFINEMENT SYSTEMS

REFER ALSO TO CITATION(S) 40649, 40675

40692 (PB—260691) **Assessment of laser-driven fusion. Final report.** Scott, F.R. (Brueckner (K.A.) and Associates, Inc., La Jolla, Calif. (USA)). Sep 1976. 162p. Q 08/MF A01.

This final report contains details of the national fusion program as of March 1976. It includes a general summary by the Laser Fusion Advisory Committee as well as a summary by the Working Group. The detailed scientific and technical evaluations of the national laser fusion program are presented in four parts, an overall assessment, engineering feasibility, scientific feasibility, and site visits.

40693 (UCRL-Trans—11230) **Laser thermonuclear fusion.** Filyukov, A.A. Mar 1977. Translation of Novoe v zhizni, Nauke, Tekhnike-Ser. Fizika, "Znanie", Moscow, 1975. 67p. P 04/MF A01.

This book gives a good review of the possibilities and problems of using laser beams to compress a thermonuclear fuel to fusion densities and temperatures. Some physical processes involved in the pulsed action of laser radiation on matter are discussed. (MOW)

40694 **Electron-beam transport for inertial fusion.** Benford, J. (Physics International Company, San Leandro, California 94577). *J. Appl. Phys.;* **48**: No. 6, 2320-2323(Jun 1977).

Two methods for transporting electron beams from the diode to a pellet are analyzed. First, pinched beams can propagate along a Z pinch with current density J/sub b/approximately-less-thanν/γJ/sub p/, where J/sub p/ is the pinch current density. Heavy high-density ($\sim 10^{16}$cm^{-3}) gas is required in order to (1) reduce plasma turbulence that could prevent total current neutralization and (2) prevent expansion of the pinch by transverse beam pressure. Second, compression in a magnetic mirror with multiple reflections between diode and mirror is considered. Reflex diode current density enhancements approximately-greater-than100 above Child's law are required for this approach to succeed.

COMPONENT DEVELOPMENT AND TESTING

40695 (BNWL—1939-6, pp 19-32) **Materials research and radiation environmental simulation.** Jan 1977.

In Pacific Northwest Laboratory report on fusion energy research, October 1976—December 1976.

The various materials and components of a fusion reactor will be subjected to extreme physical environments, intense fluxes of high energy neutrons, alpha particles, and ionic species as well as internally generated products of neutron-induced reactions, such as helium. PNL is examining the effects of these environments on candidate fusion reactor materials, using reactor irradiations and simulation techniques to: (1) determine parameters for sputtering and blistering at materials surfaces, (2) correlate changes in mechanical properties produced by light ions and fusion neutrons, (3) evaluate carbons and graphites for use as possible first-wall liner materials, and (4) determine the effects or porosity and helium buildup on the dielectric breakdown strength of electrical insulators.

40696 (COO—2456-40, pp 3-28) **Plasma-materials interaction studies.** Tien, J.K.; Gross, R.A.; Panayotou, N.F.; Stevenson, R.D. Feb 1977.

In High-beta plasma research. Progress report, February 1976—February 1977.

Fusion power reactor first-wall candidate materials have been exposed to hot deuterium plasma bombardment (10^{21} eV/cm^2). Various pure metals, stainless steels, and complex alloys have been tested. We observed blister formation, preferential erosion at grain boundaries, some surface cracking and some surface melting, and a decrease in ductility, characteristic of hydrogen embrittlement.

40697 (UCID—17168) **Mirror reactor surface study.** Hunt, A.L.; Damm, C.C.; Futch, A.H.; Hiskes, J.R.; Meisenheimer, R.G.; Moir, R.W.; Simonen, T.C.; Stallard, B.W.; Taylor, C.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Sep 1976. Contract W-7405-ENG-48. 244p. Dep. NTIS $9.00.

A general survey is presented of surface-related phenomena associated with the following mirror reactor elements: plasma first wall, ion sources, neutral beams, director converters, vacuum systems, and plasma diagnostics. A discussion of surface phenomena in possible abnormal reactor operation is included. Several studies which appear to merit immediate attention and which are essential to the development of mirror reactors are abstracted from the list of recommended areas for surface work. The appendix contains a discussion of the fundamentals of particle/surface interactions. The interactions surveyed are backscattering, thermal desorption, sputtering, diffusion, particle ranges in solids, and surface spectroscopic methods. A bibliography lists references in a number of categories pertinent to mirror reactors. Several complete published and unpublished reports on surface aspects of current mirror plasma experiments and reactor developments are also included.

40698 (UCID—17429) **DT fusion neutron irradiation of LLL niobium tensile specimens at 700°C.** MacLean, S.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Mar 1977. Contract W-7405-ENG-48. 4p. P 02/MF A01.

The DT fusion neutron irradiation of five LLL niobium tensile specimens at 700°C is described. The sample position, beam-on time, and neutron dose record are given. The maximum neutron fluence on any sample was 1.03×10^{17} neutrons/cm^2.

40699 **Irradiation effects on CTR first wall materials.** Ma, B.M. (Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.). *Nucl. Eng. Des.;* **39**: No. 1, 203-213(Oct 1976).

The selection of the controlled thermonuclear reactor (CTR) first wall material (refractory metallic alloy or austenitic stainless steel) will be a compromise based on a number of important nuclear, physical, thermal and mechanical properties, and safety, environmental, technological and economic factors. The correlations between helium production, irradiation, and helium embrittlement in the first wall depend mainly on the neutron spectrum, neutron fluence, irradiation temperature, wall material, reactor operating conditions, etc. The suppression of irradiation swelling by alloying elements (C, Si, Mo, and P) is effective and beneficial. The extent of change in mechanical properties of the first wall material due to neutron irradiation, thermal instabilities (thermal shock, thermal fatigue, crack initiation and propagation), corrosion effect, etc. remains undefined or not completely understood. A fabricated CTR first wall material must meet the requirements of design safety, weldment reliability and good operation performance.

GENERAL AND MISCELLANEOUS

MANAGEMENT

REFER ALSO TO CITATION(S) 39649, 39650

40700 (ERDA—77-41/2) **ERDA Headquarters reports: February 1977.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Administrative Services). 1977. 14p. P 02/MF A01.

ERDA headquarters reports (ERDA 77-41) normally contains four sections: (1) new ERDA Headquarters reports, (2) a cumulative list of all ERDA Headquarters reports, (3) separate lists of reports arranged by the Headquarters division/office originating them, and (4) an index to keywords in the report titles. This abridged issue omits Sections 3 and 4 and most of Section 2. Users will find the omitted material in the January 1977 issue (ERDA 77-41/1). A complete issue will again be published in March. (RWR)

40701 (ERDA—77-41/3) **ERDA Headquarters reports: March 1977.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Administrative Services). Mar 1977. 83p. P 05/MF A01.

ERDA headquarters reports (ERDA 77-41) provides a cumulative record, through various lists and an index, of the reports issued from ERDA Headquarters ("ERDA Reports"). The four sections of this publication are New ERDA Reports, a list of Headquarters reports received in the ERDA Library during the past month; Cumulative List of ERDA Reports, all ERDA Headquarters reports already issued or scheduled to be issued; Reports by Program Division, separate lists of ERDA reports arranged by the division or office at ERDA Headquarters responsible for their preparation and/or issuance; and Index to Keywords in Report Titles. (RWR)

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 39261, 39938, 40064, 40194, 40201, 40726

40702 (IS—4105) **Users manual for DISKORG: the disk organization subsystem for the PDP-15 computer.** Brobst, K.R.; Moon, L.C.; Ekberg, T. (Ames Lab., Iowa (USA)). Feb 1977. Contract W-7405-ENG-82. 20p. P 02/MF A01.

DISKORG is the name given to a set of programs written in the ALECS language which forms the disk organization subsystem of the ALECS operating system. The ALECS operating system is a time-sharing multi-tasking operating system for the DEC PDP-15 computer. The ALECS language is a subset of PL/1. The ALECS compiler (cross-compiler) runs on an IBM 360/370 OSMVT computer in about 132K Bytes of main core.

40703 (LA—6516-T) **Improved methods of maximum a posteriori image restoration.** Trussell, H.J. (Los Alamos Scientific Lab., N.Mex. (USA)). Sep 1976. Contract W-7405-ENG-36. 83p. P 05/MF A01. Thesis.

The why and how maximum a posteriori (MAP) image restoration works are explained. A new numerical iteration scheme is derived on the basis of this explanation with a convergence criterion related to the noise process. This numerical scheme is very similar to the modified Picard's method given in standard numerical analysis texts. The effects of the parameters of the MAP restoration method are predicted by the explanation and confirmed by experiment. The MAP restoration method is further improved by using local processing, i.e., processing small sections of the image sequentially and piecing them together to form the restored image. It was found, as predicted, that smaller section sizes result in better restorations. Computing costs increase as section size decreases. Although the improved MAP restoration scheme is over ten times more efficient than the old scheme, the method remains costly compared to more standard techniques. The method can be used as a refinement technique by postprocessing the output of other restoration methods. 8 figures, 3 tables.

40704 (LA—6747-MS) **Reconstruction of a source from a few (2 or 3) projections.** Minerbo, G.N.; Sanderson, J.G. (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1977. Contract W-7405-ENG-36. 40p. P 03/MF A01.

This study was undertaken to determine how well a two-dimensional source can be reconstructed from projection data when only two or three views are available. For the two-view problem, analytic solutions are obtained corresponding to several optimization criteria. These provide useful insight about reconstruction techniques, but in practice they do not produce reliable reconstructions, even for simple shapes. For the three-view problem, numerical tests with algorithms based on the Algebraic Reconstruction Technique (ART) are presented. A hexagonal raster is used to represent the source; this approach simplifies the application of ART and helps to reduce artifacts. A refinement of one of the ART algorithms is described, and numerical convergence criteria are obtained. A comparison among four algorithms for a variety of test patterns is given. Examples are considered which show the effect of noise of systematic errors in the data. The results indicate that, with three views, reliable reconstructions can be obtained, provided that the source has a limited amount of structure or is close to circular symmetry in shape. 12 figures, 3 tables.

40705 (LA—6775-MS) **Evaluation of the UNIX time-sharing system.** Melendez, K.J.; Johnson, R.T. (Los Alamos Scientific Lab., N.Mex. (USA)). Apr 1977. Contract W-7405-ENG-36. 14p. P 02/MF A01.

In April, 1976, the Applications Support and Research Group of the Los Alamos Scientific Laboratory (LASL) was assigned the task of performing a six-month evaluation of UNIX, a time-sharing system developed by Bell Laboratories. This report is the final evaluation of the system, covering availability, reliability, and maintainability; system usage; potential UNIX usage; and recommendations. The evaluation team concluded that UNIX would be a valuable addition to the computer network at LASL.

40706 (LA-UR—77-633) **Software for approximations or approximation theory as an experimental science.** Fullerton, L.W. (Los Alamos Scientific Lab., N.Mex. (USA)). 1977. Contract W-7405-ENG-36. 14p. P 02/MF A01.

Numerical analysis and approximation theory, in particular, can be an experimental science. This experimental nature is illustrated with several more-or-less new results. In the first half of this paper techniques for estimating the accuracy and significance of approximations are given. In the second half several generalizations of Chebyshev series that lead to nearly best approximations with respect to almost arbitrary weight functions and basis sets are presented.

40707 (LBL—5594) **Computer networks in the physical sciences.** Austin, D.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 10 Nov 1976. Contract W-7405-ENG-48. 24p. (CONF-761159—1). P 02/MF A01.

From Conference on computer networks in the physical sciences; Boston, Massachusetts, United States of America (USA) (11 Nov 1976).

The concept of the computer network is discussed in a nontechnical way. The network allows sharing of very expensive hardware and highly developed software. The ERDA Network Experimentation Project was established to explore the use of distributed computer networks as a potential long-term solution to the problems of reliable access to unique computational facilities and large data bases throughout ERDA. The capabilities of a distributed network are described with respect to hardware resources, software resources, data bases, and research collaboration. Examples of applications considered include partial-wave analysis, track-sensitive-target experiment data analysis, mathematical software portability, gateways between networks, and teleconferencing. Future problems and developments are outlined. 11 figures. (RWR)

40708 (LTSS—10(Ed.7)) **Livermore timesharing system. Part 1: Octopus. Chapter 10: CDC 7600 system calls and I/O requests.** Du Bois, P.; Coverston, H.; Storch, D.; Powles, G.; von Buskirk, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Nov 1975. Contract W-7405-ENG-48. 107p. P 06/MF A01.

This document discusses CDC 7600 system calls and I/O requests in the Livermore Time-sharing System. A system call is a request by a problem program for some function or service to be performed by the resident executive program (FLOE or EEA). The functions available include accessing files, communicating with terminal devices and with controllers and controllees, obtaining system tables and information, etc. After a general introduction to system calls, calls to FLOE and to EEA are dealt with in detail. Then an introduction to input/output requests is given. Finally, available I/O programs and error indications are discussed. The document is very detailed and specific in nature, and would probably be of interest only to those actually using LLL computer systems. 6 figures, 5 tables. (RWR)

40709 (LTSS—305(Ed.1)) **Livermore Timesharing System. Part 4: library files. Chapter 305: TV80LIB graphics library.** Storch, N.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Sep 1975. Contract W-7405-ENG-48. 72p. P 04/MF A01.

This report describes a library of graphics subroutines and device processors, generally known as "TV80", which can be used in Fortran programs to produce pictures on a number of different output devices. These include television, microfilm, electrostatic printers, and storage tubes. TV80 is device-independent; that is, calls to make pictures are independent of the particular output devices that are selected during execution. Included in TV80 are both simple, two-dimensional drawing routines for lines, points, and characters, and complex routines that draw contours, grids, and three-dimensional objects. Details of the complex routines are given in the references. The TV80 graphics package is available for use on the CDC 7600 and CDC STAR-100 computers of the Laboratory's Octopus timesharing system. 12 figures, 3 tables.

40710 (ORNL/CSD—21) **ALPS: matrices with nonpositive off-diagonal entries.** Berman, A.; Varga, R.S.; Ward, R.C. (Oak Ridge National Lab., Tenn. (USA)). Mar 1977. Contract W-7405-ENG-26. 21p. P 02/MF A01.

This paper characterizes and interrelates various degrees of stability and semipositivity for real square matrices having nonpositive off-diagonal entries. The major classes considered are the sets of diagonally stable, stable, and semipositive matrices, denoted respectively by a, L, and S. The conditions defining these classes are weakened, and the resulting classes are examined. Their relationship to the classes of real matrices P and P_0, whose off-diagonal entries are nonpositive and whose principal minors are, respectively, all positive and all nonnegative, is also included.

40711 (ORNL/TM—5807) **User's guide for the computer program DASAVOR: data storage and variable output recovery system.** Jubin, R.T.; Moore, J.G. (Oak Ridge National Lab., Tenn. (USA)). May 1977. Contract W-7405-ENG-26. 33p. P 03/MF A01.

A data storage and recovery system was devised to allow the rapid collation and presentation of large quantities of data in three usable forms: a listing of all data on each experiment, a listing of preselected data, and a plot of any set of data points. The system employs a punch card data storage system, a card sorter, and a FORTRAN computer program. 7 figures.

40712 (ORO—5046-2) **Diagonalized multiplier methods and quasi-Newton methods for constrained optimization.** Tapia, R.A. (Rice Univ., Houston, Tex. (USA). Dept. of Mathematical Sciences). 1976. Contract EY-76-S-05-5046. 80p. Dep. NTIS $5.00.

Two approaches to quasi-Newton methods for constrained optimization problems in R/sup n/ are presented. These approaches

are based on a class of Lagrange multiplier approximation formulas used in previous work on Newton's method for constrained problems. The first approach is set in the framework of a diagonalized multiplier method. From this point of view a new update rule for the Lagrange multipliers which depends on the particular quasi-Newton method employed is given. This update rule, in contrast to most other update rules, does not require exact minimization of the intermediate unconstrained problem. In fact, the optimal convergence rate is attained in the extreme case when only one step of a quasi-Newton method is taken on this intermediate problem. The second approach transforms the constrained optimization problem into an unconstrained optimization problem of the same dimension. 4 tables.

40713 (SAND—76-0648) **Collection of equations for low-degree least-squares polynomials.** Clark, E.L. Jr. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1977. Contract EY-76-C-04-0789. 89p. P 05/MF A01.

The least-squares normal equations are solved for general functions having one to three coefficients that occur linearly. Expressions are given for evaluating the coefficients of the most useful low-degree least-squares polynomials. Simplified equations are derived for smoothing and differentiating data that is equally spaced in the independent variable. It is shown that a least-squares polynomial, if fit to an odd number of equally spaced points and evaluated at the midpoint of the fit, acts as a digital filter. Equations for the frequency response of the filter are given and expressions for the filter weights are derived which permit more efficient smoothing than is possible with conventional techniques. 5 figures, 2 tables.

40714 (SAND—77-0162) **User/programmer guide for UCMD 52: superimposition of rectangles by polygons.** Wiegandt, K.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). Feb 1977. Contract EY-76-C-04-0789. 20p. Dep. NTIS $3.50.

This document describes program UCMD 52—an Applicon AGS/870 User Command for superimposing selected rectangles of nonzero X and Y length with a polygon or path identified by the component mode in effect at execution time. 3 figures.

40715 (UCID—17373) **Memory Map Unit, Interdata 7/16 HSALU: description and instructions.** Butner, D.N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Feb 1977. Contract W-7405-ENG-48. 21p. Dep. NTIS $3.50.

The Memory Map Unit (MMU) provides the capability for an Interdata 7/16 computer with High Speed Arithmetic Logic Unit (HSALU) to operate with up to 256K bytes of memory (1K = 1024). Memory addresses, consisting of 16 bits, are mapped into 18 bits whenever a memory cycle occurs. Mapping occurs by 1K pages; selectable low-address areas are not mapped. 4 figures.

40716 (UCID—17415) **Areal mapping of arbitrary plane regions onto rectangular meshes.** Warshaw, S.I. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1977. Contract W-7405-ENG-48. 23p. P 02/MF A01.

A simple and powerful method is presented for calculating all areas of intersection that occur when a plane region of arbitrary shape and connectivity overlaps the cells of a rectangular mesh. This procedure has been successfully used in an algorithm for a digital computer, and details are given for a unique procedure which effectively sidesteps floating point problems associated with machine noise. A simplifying procedure is also outlined for areal mapping of a collection of complex planar configurations onto a rectangular Eulerian mesh. 11 figures, 1 table.

40717 (UCID—30112(Rev.1)) **EPISODE: an effective package for the integration of systems of ordinary differential equations.** Hindmarsh, A.C.; Byrne, G.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1977. Contract W-7405-ENG-48. 69p. P 04/MF A01.

EPISODE is a package of subroutines written in FORTRAN. When these subroutines are used together in the manner described here, they provide the numerical solution of the initial-value problem for systems of ordinary differential equations. EPISODE contains both a variable-step, variable-order implicit Adams method and a variable-step, variable-order backward differentiation method. Since the user may select either of these methods simply by assigning the appropriate value to a method flag, EPISODE can be used to solve either stiff or non-stiff problems. Similarly, the user also selects one of four corrector iteration methods to be used. The EPISODE package is supplied in double precision to users outside Lawrence Livermore Laboratory (LLL), but it contains the single-precision version imbedded in it. Conversion to single precision can be easily done with a converter subroutine, supplied with the package. Development and testing work on EPISODE has been done on both CDC equipment at LLL and IBM equipment at Argonne National Laboratory (ANL), and earlier versions have been in use for over three years. 3 figures.

40718 (UCID—30146) **UXDD80 graphics system.** Blair, M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jan 1977. Contract W-7405-ENG-48. 32p. P 03/MF A01.

This report describes a system of graphics software for use with Fortran plotting programs produced with LLL's PUTT (Fortran-IV) and CHAT (extended-Fortran) compilers. It consists of libraries containing subroutines that may be used in conjunction with the Laboratory's "dd80 plotting routines" to construct a program that will output pictures in the form of a general-purpose graphics database and a family of utility programs that process pictures from the database to display and/or output them in an assortment of forms on various graphics devices. Output devices include television monitors and several varieties of electrostatic printers. The system's fundamental strength lies in the nature of its database, which is both simple and device-independent (i.e., not tailored to any particular device or application). The software is available from the public file system of LLL's Octopus timesharing network, for use on any of its four CDC 7600 computers.

40719 (UCRL—52157) **CAGN: a computer program for point source, transient, elastic, ultrasonic longitudinal and shear waves.** Nickerson, R.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1976. Contract W-7405-ENG-48. 143p. P 07/MF A01.

A computer program, CAGN, was developed that computes displacements of solids and displacements or pressures of liquids. The mathematical model is for a point source of elastic waves at a height, h, above the plane boundary of two semi-infinite elastic media. The media may be solids or liquids or vacuum (for free surfaces); the sources may be longitudinal (seismic P waves) or either of two shear polarizations (seismic S/sub V/ or S/sub H/ waves). Analysis of equations developed in the solution of the wave propagation clarifies the mechanisms of critical refraction and surface wave formation. The code provides more exact solutions of the response waveform from a given input waveform which should illuminate present frequency analysis problems. 22 figures, 2 tables.

40720 **Approximation by polynomials increasing to the right of the interval.** Ling, W.H. (Union Coll., Schenectady, NY); Roulier, J.A.; Varga, R.S. *J. Approx. Theory;* **14**: No. 4, 285-295(Aug 1975).

Sufficient conditions on a real valued function f, continuous on (0, + infinity), are obtained to insure that, for some nonnegative integer n, there is a nonnegative number r(n) so that, for any r greater than or equal to r(n), the polynomial of best approximation to f on [0,r] from pi/sub n/ is increasing and nonnegative on (r, + infinity). Here, pi/sub n/ denotes the set of all real polynomials of degree n or less. Two proofs use only properties of Lagrange interpolation, while a third employs results on the location of interpolation points in Chebyshev approximation.

40721 **Geometric convergence to e-/sup z/ by rational functions with real poles.** Saff, E.B. (Univ. of South Florida, Tampa); Schoenhage, A.; Varga, R.S. *Numer. Math.;* **25**: 307-322(1976).

It is shown that there exists a sequence of rational functions of the form R/sub n/(z) = p/sub n-1/ (z)/(1 + z/n)/sup n/, n = 1, 2, . . ., with deg p/sub n-1/ less than or equal to n - 1, which converges geometrically to e/sup -z/ in the uniform norm on [0, + infinity], as well as on some infinite sector symmetric about the positive real axis. The usefulness of such rational functions in approximating the solutions of heat-conduction type problems is also discussed. 2 tables.

40722 **Convergence of the symmetric SOR method.** Alefeld, G. (Univ., Karlsruhe); Varga, R.S. *Numer. Math.;* **25**: 291-295(1976). (In German).

For the iterative solution of the matrix equation Ax = b by means of the (point) symmetric SOR method (called the SSOR method), the basic convergence analysis of this iterative process has been developed in the literature only for the case when A is Hermitian and positive definite. With the help of the theory of regular splittings, a more general convergence analysis of this iterative method is obtained, under the weaker assumption that A is a nonsingular H-matrix.

40723 **Proceedings of the 1976 summer computer simulation conference.** La Jolla, CA; Simulation Councils, Inc. (1976). 1062p. (CONF-760703—).

From Summer computer simulation conference; Washington, District of Columbia, United States of America (USA) (12 Jul 1976).

Forty-four papers are abstracted and indexed individually for publication in ERDA Energy Abstracts (ERA). Thirteen of these are included in Energy Abstracts for Policy Analysis(EAPA). Nine papers had been processed previously. (JGB)

40724 **Squared power method to fit a plane to a set of points.** Andrews, L.C.; Bernstein, H.J. (Brookhaven National Lab., Upton, NY). *Acta Crystallogr., Sect. A;* **32**: No. 3, 504-506(May 1976).

The "power method" provides a computationally easy method for the determination of the best plane through a set of points. By repeatedly taking squares, one rapidly obtains the maxi-

mum eigenvalue and corresponding eigenvector of the inertia tensor. The result is the least-squares result when the points have independent, isotropic weights.

40725 Zero-free parabolic regions for sequences of polynomials. Saff, E.B. (Univ. of South Florida, Tampa); Varga, R.S. *SIAM J. Math. Anal.;* 7: No. 3, 344-357(May 1976).

It is shown that certain sequences of polynomials [p/sub k/(z)]/sub k = 0//sup n/, generated from three-term recurrence relations, have no zeros in parabolic regions in the complex plane of the form y^2 less than or equal to $4\alpha(x + \alpha)$, $x < -\alpha$. As a special case of this, no partial sum s/sub n/(z) = Σ/sub k = 0//sup n/ z/sup k// k-factorial of e/sup z/ has a zero in y^2 less than or equal to $4(x + 1)$, $x < -1$, for any n greater than or equal to 1. Such zero-free parabolic regions are obtained for Pade approximants of certain meromorphic functions, as well as for the partial sums of certain hypergeometric functions. 3 figures.

INFORMATION HANDLING

REFER ALSO TO CITATION(S) 39651, 40500

40726 (BNL—22445) **Architecture of the BNL archive and dissemination system.** Heller, J. (Brookhaven National Lab., Upton, N.Y. (USA)). Dec 1976. Contract EY-76-C-02-0016. 61p. P 04/MF A01.

The Brookhaven National Laboratory Archive and Dissemination System (BNLADS) was designed to cope with logical accessing of sequential files, the dissemination of subsets of sequential files of data, the reformatting of sequential files of data, and the record keeping associated with these archiving and disseminating activities. The broad specifications and desires of the BNLADS are discussed from the point of view that eventually this system will operate in a nonhomogeneous computer network. Then the nature of sequential files as dealt with by the BNLADS is considered. A data definition language (DDL) is specified that is capable of describing the access sequence, formatting, and logical names of the fields of data. This DDL is used by the system for accessing sequential files and formatting data for output onto user specified files. The formal specification in Baccus Naur Form (BNF) is given with a discussion of the sematics of the DDL. The architecture of the BNLADS, i.e., the stratified organization, is examined next. The version used is an intersection of the PL/I which is common to all manufacturers considered. The architecture of the BNLADS requires a physical logical description (PLD) of sequential files of data. The BNF form of the PLD is presented. Finally, data accessing language (DAL) upon which the application programs (AP) are written is discussed. These DAL procedures are written in PL/I and can be used to write AP; three typical AP are explained. These AP are characteristic of utility programs and deal with constructing an "archive type" file, if desired, displaying the contents, selectively, of a file, and reformatting a sequential file. 7 figures (RWR)

40727 (PB—257501) **Environmental Protection Agency library systems book catalog. Holdings for the year 1975.** (Environmental Protection Agency, Washington, D.C. (USA)). Jun 1975. 525p. (EPA-LIB—76-04). NTIS $12.75.

See also report dated Jan 1975, PB—243568.

The U.S. Environmental Protection Agency Library System Book Catalog of holdings from January to December 1975, has been published in a single volume. The full catalog lists alphabetically by title the complete entry for each book owned by the individual EPA libraries. The indexes to the Book Catalog are in two parts: Part 1, the Author index, lists each author in alphabetical order; the Subject Index, Part 2, lists, in alphabetical order, the subject headings assigned to the books in the catalog. (GRA)

LAW

REFER ALSO TO CITATION(S) 39667

CIVILIAN DEFENSE

40728 (HRP—0000092) **A model for multi-hospital preparedness.** (Office of Emergency Preparedness, Washington, D.C. (USA); Health Services and Mental Health Administration, Rockville, Md. (USA). Div. of Emergency Health Services). 1971. 16p. NTIS $3.50.

Prepared in cooperation with Health Services and Mental Health Administration, Rockville, Md. Div. of Emergency Health Services, Office of Civil Defense, Washington, D.C., and Hospital Council of Southern California, Los Angeles.

The study documents a multi-hospital disaster preparedness program as it was developed by a group of four prominent Los Angeles hospitals: Cedars of Lebanon Hospital, Childrens Hospital of Los Angeles, Hollywood Presbyterian Hospital, and Kaiser Foundation Hospital. It has been determined that the individualistic approach to disaster planning is obsolete, but that medical and hospital groups working together can respond effectively. In the Southern California model, the initiative for implementing the disaster plan was provided by the director of Outpatient Services for Childrens Hospital of Los Angeles. The original group of hospital representatives meets monthly. (GRA)

CORPORATE INDEX

In the corporate index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

ERDA Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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262	2:39536	Dep. NTIS, PC A03/MF A01
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N-		
76-26716	2:40228	NTIS, $4.00
76-26718	2:40178	NTIS, $3.50
76-26975	2:39480	NTIS, $3.50
76-26984	2:40179	NTIS, $4.50
76-27151	2:40509	NTIS, $4.00
76-27161	2:40621	NTIS, $3.50
76-27362	2:39894	NTIS, $3.50
76-27363	2:39895	NTIS, $3.50
76-27478	2:40679	NTIS, $5.50
76-27594	2:40619	NTIS, $3.50
76-27696	2:39408	NTIS, $6.00
76-27727	2:40019	NTIS, $5.00
76-28121	2:40506	NTIS, $3.50
76-28136	2:40513	NTIS, $3.50
76-28139	2:40514	NTIS, $4.00
76-28390	2:39985	NTIS, $6.00
76-28453	2:40510	NTIS, $4.00
76-28474	2:40107	NTIS, $10.00
76-28479	2:40106	NTIS, $4.00
76-28544	2:40029	NTIS, $6.00
76-28980	2:40031	NTIS, $4.00
76-29146	2:40515	NTIS, $4.00
76-29380	2:39983	NTIS, $3.50
76-29386	2:39918	NTIS, PC A05/MF A01
76-29591	2:39849	NTIS, $3.50
NASA-CP-		
2001	2:40002	*See* COO-3077-134

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NASA-CR-		
134982	2:40029	*See* N-76-28544
148210	2:40179	*See* N-76-26984
148476	2:40515	*See* N-76-29146
148510	2:40107	*See* N-76-28474
148511	2:39985	*See* N-76-28390
148531	2:40031	*See* N-76-28980
148598	2:39983	*See* N-76-29380
NASA-TM-X-		
3388	2:40621	*See* N-76-27161
71137	2:40506	*See* N-76-28121
71157	2:40514	*See* N-76-28139
71166	2:40106	*See* N-76-28479
73317	2:40509	*See* N-76-27151
73324	2:39849	*See* N-76-29591
NASA-TN-D-		
8182	2:40178	*See* N-76-26718
NASA-TT-F-		
15487	2:40513	*See* N-76-28136
17033	2:40228	*See* N-76-26716
17070	2:39894	*See* N-76-27362
17071	2:39895	*See* N-76-27363
17128	2:40510	*See* N-76-28453
NBS-BSS-		
69	2:39723	GPO, $4.60
78	2:39732	GPO, $1.25
88	2:39724	*See* PB-259761
NBS-SPEC.PUBL.-		
434	2:39691	GPO, $0.55
NBS-TN-		
923	2:39743	*See* PB-259629
NLCO-		
1142	2:40200	Dep. NTIS, PC A03/MF A01
NOAA-TM-ERL-MESA-		
6	2:40235	*See* PB-258063
NOAA-TR-ERL-		
355	2:40171	*See* PB-256091
357	2:40508	*See* PB-256131
NP-		
21727	2:39382	NTIS, PC A09/MF A01
21735	2:39707	Dep. NTIS (US Sales Only), PC A01/MF A01
21746	2:39733	Dept. of Agricultural, Economic Research Service, Washington, DC
21767	2:40217	Thorne Ecological Inst., Boulder, CO
21769	2:39653	Dep. NTIS (US Sales Only), PC A01/MF A01
21778	2:40586	Dep. NTIS (US Sales Only), PC A02/MF A01
21780	2:39703	TIC
21792	2:39221	Bureau of Domestic Commerce (1976).
21793	2:39201	American Petroleum Institute (1975).
21794	2:39197	American Petroleum Institute (1974).
21796	2:39198	American Petroleum Institute (1974).
21797	2:40077	American Petroleum Institute (1976).
21798	2:39199	American Petroleum Institute (1974).
NP-tr-		
1959	2:39044	Dep. NTIS (US Sales Only), PC A02/MF A01
1960	2:39047	Dep. NTIS (US Sales Only), PC A02/MF A01
1961	2:39043	Dep. NTIS (US Sales Only), PC A02/MF A01
1962	2:39045	Dep. NTIS (US Sales Only), PC A02/MF A01
1963	2:39109	Dep. NTIS (US Sales Only), PC A02/MF A01
1964	2:39726	Dep. NTIS (US Sales Only), PC A02/MF A01
1965	2:39555	Dep. NTIS (US Sales Only), PC A02/MF A01
1966	2:39118	Dep. NTIS (US Sales Only), PC A02/MF A01
1967	2:39108	Dep. NTIS (US Sales Only), PC A02/MF A01
1968	2:39134	Dep. NTIS (US Sales Only), PC A02/MF A01
1970	2:39532	Dep. NTIS (US Sales Only), PC A03/MF A01
1971	2:39046	Dep. NTIS, PC A02/MF A01
1972	2:40103	Environmental Protection Agency, NERC-Library, Washington, DC
NR/ASG-		
001	2:39544	*See* PB-258233
NSF/RANN/GI-		
41891/FR/75/4	2:39426	Dep. NTIS, $5.00
NTISUB/B-		
108	2:39576	Paper copy also available on subscription, North American Continent price, $60.00/year; all others write for quote
124-76/008	2:39529	NTIS, PC A05/MF A01
127-76/010	2:39692	NTIS, PC A05/MF A01
NUREG-		
0015	2:39358	*See* PB-256962
0015-ES	2:39359	*See* PB-256963
0025-8	2:39529	*See* NTISUB/B-124-76/008
0109	2:39481	*See* PB-257054
0135-1	2:39576	*See* NTISUB/B-108
0171	2:39552	Dep. NTIS, $4.50
0179	2:39506	*See* SAND-76-0721
0207(Draft)	2:39530	Dep. NTIS, PC A03/MF A01
760145	2:39354	*See* SAND-76-0500
ORC-		
25008-Vol-20	2:39699	*See* PB-261161
25008-Vol-21	2:39675	*See* PB-261162
25008-Vol-22	2:39676	*See* PB-261163
25008-Vol-23	2:39677	*See* PB-261164
25008-Vol-24	2:39678	*See* PB-261165
ORI-TR-		
1011	2:39569	*See* AD-A-029165
ORNL-		
5073	2:39863	AT
5145	2:39845	AT
5188	2:39487	Dep. NTIS, PC A09/MF A01
5216	2:39996	Dep. NTIS, PC A03/MF A01
5222	2:39855	AT
5243	2:39846	AT
ORNL/CON-		
8	2:39709	Dep. NTIS, PC A04/MF A01
ORNL/CSD-		
21	2:40710	Dep. NTIS, PC A02/MF A01
ORNL/CSD/TM-		
11	2:40126	Dep. NTIS, PC A03/MF A01
ORNL/MIT-		
237	2:39051	Dep. NTIS, PC A03/MF A01
238	2:39936	Dep. NTIS, PC A03/MF A01
ORNL/NSF/EATC-		
27	2:40207	*See* EDFB/IBP-76/8
ORNL/NUREG/TM-		
104	2:39577	Dep. NTIS, PC A03/MF A01
ORNL/RUS-		
26	2:40250	Dep. NTIS, PC A05/MF A01
ORNL/Sub/4269-		
9	2:39338	Dep. NTIS, $5.00
ORNL/Sub/38283-		
75/3	2:39185	Dep. NTIS, $4.50
ORNL/TM-		
5262	2:40677	Dep. NTIS, $10.00
5459	2:39562	Dep. NTIS, PC A04/MF A01
5703	2:39535	Dep. NTIS, PC A07/MF A01
5723	2:39311	AT
5807	2:40711	Dep. NTIS, PC A03/MF A01
5830	2:40201	Dep. NTIS, PC A05/MF A01
5834	2:40499	Dep. NTIS, $4.00
ORNL-tr-		
4271	2:40221	Dep. NTIS, PC A02/MF A01
4273	2:39903	Dep. NTIS, PC A03/MF A01
4318	2:40631	Dep. NTIS, PC A02/MF A01
4322	2:39276	Dep. NTIS, PC A02/MF A01
4325	2:40460	Dep. NTIS, PC A02/MF A01
4329	2:40652	Dep. NTIS, PC A03/MF A01
4331	2:39325	Dep. NTIS, PC A03/MF A01
4333	2:39540	Dep. NTIS, PC A02/MF A01
4341	2:40483	Dep. NTIS, PC A02/MF A01
4343	2:40471	Dep. NTIS, PC A02/MF A01
4348	2:40245	Dep. NTIS, PC A02/MF A01
ORO-		
2504-251	2:40561	Dep. NTIS, $7.75
4936-2	2:40587	Dep. NTIS, $5.00
5046-2	2:40712	Dep. NTIS, $5.00
5111-1	2:39856	Dep. NTIS, PC A02/MF A01

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ORP/EAD-		
76/1	2:40487	*See* PB-257077
ORP/LV-		
76-7	2:40690	*See* PB-255502
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2,443,843/A/	2:39313	
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A 652,696	2:39630	
A 657,525	2:39631	
A 675,086	2:39333	
A 683,156	2:39300	
A 686,446	2:40008	
A 690,498	2:39794	
A 696,997	2:39301	
3,941,510	2:39200	
3,941,511	2:39202	
3,949,220	2:39195	
3,967,936	2:39079	
3,969,495	2:39370	
3,970,434	2:39080	
3,971,634	2:39081	
3,980,495	2:39632	
3,981,690	2:39082	
3,983,392	2:39146	
3,985,078	2:39715	
3,985,595	2:40116	
3,985,841	2:39362	
3,987,145	2:39939	
3,987,146	2:39457	
3,987,302	2:39934	
3,988,123	2:39087	
3,988,919	2:39922	
3,989,480	2:39381	
3,989,484	2:39364	
3,989,608	2:39940	
3,989,808	2:39949	
3,991,599	2:40009	
3,991,680	2:40117	
3,991,898	2:39368	
3,993,450	2:40010	
3,993,458	2:39373	
3,993,538	2:39997	
3,993,579	2:39334	
3,993,728	2:39315	
3,993,910	2:40095	
3,994,629	2:39423	
3,995,136	2:40633	
3,996,331	2:39941	
3,997,005	2:39089	
3,997,365	2:39633	
3,997,435	2:39363	
3,999,986	2:39850	
4,000,004	2:39634	
4,000,005	2:39638	
4,000,013	2:39852	
4,000,014	2:39851	
4,000,036	2:40634	
4,000,350	2:39616	
4,000,352	2:39637	
4,000,388	2:39636	
4,000,453	2:39635	
4,001,717	2:39806	
4,002,493	2:39719	
4,004,943	2:39641	
4,004,945	2:39640	
4,005,235	2:39892	
4,006,096	2:39491	
4,007,015	2:39369	
4,007,059	2:39642	
4,007,085	2:39546	
4,007,595	2:39493	
4,007,596	2:39492	
4,007,597	2:39494	
4,008,099	2:39620	
4,008,100	2:39643	
4,008,354	2:39644	
4,008,355	2:39621	
4,008,455	2:39519	
4,008,576	2:39159	
4,009,052	2:39622	
4,009,243	2:39053	
4,009,320	2:39623	
4,009,323	2:39645	
4,009,395	2:39424	
4,009,396	2:39425	
4,009,872	2:39753	
4,009,933	2:40034	
4,010,008	2:39378	
4,010,249	2:39371	
4,010,363	2:40035	
4,010,396	2:40085	
4,010,397	2:40036	
4,010,407	2:39785	
4,010,427	2:40037	
4,010,534	2:39366	
4,010,621	2:39729	
4,010,622	2:39275	
4,010,723	2:39824	
4,010,731	2:39612	
4,011,296	2:39316	
4,011,298	2:39459	
4,011,299	2:39458	
4,011,396	2:39474	
4,011,521	2:40039	
4,011,522	2:40038	
4,011,525	2:40040	
4,011,716	2:39807	
4,011,718	2:39805	
4,011,725	2:39814	
4,011,736	2:39613	
4,011,839	2:39804	
4,011,843	2:39803	
4,011,845	2:39825	
4,011,846	2:39813	
4,011,903	2:39730	
4,011,909	2:39234	
4,011,910	2:39235	
4,012,191	2:39755	
4,012,231	2:39760	
4,012,314	2:39096	
4,012,489	2:39296	
4,012,637	2:40062	
4,012,640	2:40041	
4,012,677	2:39788	
4,012,680	2:39787	
4,012,681	2:39786	
4,012,912	2:39448	
4,013,399	2:40073	
4,013,430	2:39460	
4,013,516	2:40069	
4,013,732	2:39379	
4,013,781	2:39372	
4,013,818	2:39624	
4,014,790	2:40070	
4,015,053	2:39646	
4,015,054	2:39625	
PB-		
251905	2:40341	NTIS, $6.00
255130	2:40143	NTIS, $4.50
255266	2:40231	NTIS, $8.00
255300	2:39144	NTIS, $3.50
255363	2:40392	Dep. NTIS, $6.00
255454	2:40180	NTIS, $4.50
255502	2:40690	NTIS, $4.50
255572	2:40246	NTIS, $4.50
255576	2:40203	NTIS, $4.00
255608	2:39241	NTIS, $10.00
255629	2:40399	NTIS, $4.00
255630	2:39537	NTIS, $3.50
255698	2:40172	NTIS, $4.50
255727	2:40249	NTIS, $4.50
255794	2:40236	NTIS, $4.00
255819	2:39399	NTIS, $4.50
255842	2:39078	NTIS, $9.75
255886	2:40176	NTIS, $3.50
255892	2:40342	NTIS, $4.50
255901-T/SL	2:39601	NTIS, $7.50
255908	2:39553	NTIS, $4.00
255937	2:40241	NTIS, $5.50
255950	2:40216	NTIS, $4.00
255956	2:39246	NTIS, $4.50
256029	2:40343	NTIS, $4.00
256091	2:40171	NTIS, $4.00
256131	2:40508	NTIS, $5.00

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256262	2:39556	NTIS, $4.50
256397	2:40177	NTIS, $7.50
256588	2:40230	NTIS, $5.00
256634	2:39182	Source tape is in EBCDIC character set. Tape can be prepared in most standard 7 or 9 track recording modes for one-half inch tape. Identify recording mode desired by specifying character set, tract, density, and parity. Call NTIS Computer Products if you have questions. Price includes documentation, PB-256635, User's Guide
256635	2:39183	NTIS, $9.25
256678	2:40397	NTIS, $4.50
256679	2:39551	NTIS, $6.00
256698	2:40444	NTIS, $3.50
256939	2:40248	NTIS, $5.00
256962	2:39358	NTIS, $6.00
256963	2:39359	NTIS, $4.00
257054	2:39481	NTIS, $3.50
257077	2:40487	NTIS, $3.50
257096	2:39452	NTIS, $9.00
257097	2:39453	NTIS, $7.75
257138	2:40486	NTIS, $4.50
257237	2:40173	NTIS, $10.50
257240	2:40174	NTIS, $9.00
257307	2:39317	NTIS, $4.50
257449	2:40234	NTIS, $4.50
257501	2:40727	NTIS, $12.75
257529	2:40175	NTIS, $6.75
257532	2:39602	NTIS, $6.75
257568	2:39603	NTIS, $4.50
257673	2:40448	NTIS, $5.50
257707	2:40181	NTIS, $9.00
257734	2:40229	NTIS, $3.50
257746	2:39430	NTIS, $5.50
257888	2:39367	NTIS, $9.00
257937	2:40435	NTIS, $6.75
257952	2:39557	NTIS, $7.50
258039	2:40401	NTIS, $3.50
258063	2:40235	NTIS, $10.50
258128	2:39545	NTIS, $4.00
258159	2:40398	NTIS, $4.50
258164	2:39343	NTIS, $5.00
258167	2:40396	NTIS, $4.00
258168	2:40184	NTIS, $9.00
258233	2:39544	NTIS, $3.50
258523	2:39451	NTIS, $7.75
258568	2:40011	NTIS, PC A02/MF A01
258766	2:39242	NTIS, PC A03/MF A01
259203	2:39132	NTIS, PC A04/MF A01
259204	2:39661	NTIS, PC A03/MF A01
259332	2:39578	NTIS, PC A04/MF A01
259629	2:39743	NTIS, PC A03/MF A01
259722	2:39392	NTIS, PC A04/MF A01
259761	2:39724	NTIS, PC A02/MF A01
259764	2:39757	NTIS, PC A11/MF A01
259914	2:40127	NTIS, PC A03/MF A01
259947	2:40393	NTIS, PC A04/MF A01
259998	2:39725	NTIS, PC A03/MF A01
260478	2:39171	NTIS, PC A10/MF A01
260554	2:39539	NTIS, PC A07/MF A01
260555	2:40630	NTIS, PC A04/MF A01
260559	2:39339	NTIS, PC A05/MF A01
260562	2:40688	NTIS, PC A05/MF A01
260582	2:39461	NTIS, PC A06/MF A01
260583	2:39579	NTIS, PC A04/MF A01
260584	2:39353	NTIS, PC A08/MF A01
260643	2:39650	NTIS, PC A07/MF A01
260653	2:40672	NTIS, PC A06/MF A01
260655	2:39548	NTIS, PC A20/MF A01
260662	2:40128	NTIS, PC A04/MF A01
260664	2:39062	NTIS, PC A03/MF A01
260691	2:40692	NTIS, PC A08/MF A01
260860	2:39758	NTIS, PC A02/MF A01
260861	2:39759	
261161	2:39699	NTIS, PC A03/MF A01
261162	2:39675	NTIS, PC A03/MF A01
261163	2:39676	NTIS, PC A03/MF A01
261164	2:39677	NTIS, PC A03/MF A01
261165	2:39678	NTIS, PC A02/MF A01
261365	2:39710	NTIS, PC A12/MF A01
261470	2:39580	NTIS, PC A06/MF A01
261471	2:39581	NTIS, PC A12/MF A01

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PC-NAS-004	2:40031	*See* N-76-28980
PERC/RI-77/3	2:39106	Dep. NTIS, $3.50
77/6	2:39107	Dep. NTIS, PC A03/MF A01
PPPL-1338	2:40651	Dep. NTIS, PC A02/MF A01
PR-237	2:40228	*See* N-76-26716
PRS-8	2:39757	*See* PB-259764
PSU-IRL-SCI-447	2:39985	*See* N-76-28390
448	2:39983	*See* N-76-29380
Pub-71	2:39242	*See* PB-258766
PUBL-12	2:39480	*See* N-76-26975
R-76-912038-12	2:40029	*See* N-76-28544
RDT-STATUS-4-77	2:39531	RSO
REPT-756	2:40679	*See* N-76-27478
RFP-2462	2:39347	Dep. NTIS, PC A02/MF A01
SA/TIB-26	2:40203	*See* PB-255576
29	2:40246	*See* PB-255572
SAI/EF-75-26	2:40175	*See* PB-257529
SAN/1140-1/2	2:39420	Dep. NTIS, $10.50
SAND-76-0136	2:40108	Dep. NTIS, PC A09/MF A01
76-0280	2:40003	Dep. NTIS, PC A05/MF A01
76-0500	2:39354	Dep. NTIS, PC A03/MF A01
76-0603	2:40014	Dep. NTIS, $4.00
76-0648	2:40713	Dep. NTIS, PC A05/MF A01
76-0671	2:40018	Dep. NTIS, PC A02/MF A01
76-0721	2:39506	Dep. NTIS, PC A03/MF A01
76-0729	2:39405	Dep. NTIS, PC A03/MF A01
77-0004	2:39398	Dep. NTIS, PC A02/MF A01
77-0034	2:39663	Dep. NTIS, PC A04/MF A01
77-0162	2:40714	Dep. NTIS, $3.50
77-0196	2:39277	Dep. NTIS, PC A04/MF A01
77-0452C	2:39355	Dep. NTIS, PC A02/MF A01
77-0616	2:40202	Dep. NTIS, PC A02/MF A01
77-6005	2:39604	Dep. NTIS, PC A02/MF A01
77-8503	2:40064	Dep. NTIS, PC A04/MF A01
SEL-37	2:40508	*See* PB-256131
SR-111	2:39133	Pennsylvania State Univ., University Park
SSDC-9	2:40491	*See* ERDA-76-45/9
TDCK-67112	2:40619	*See* N-76-27594
TI-5040-TSA0002	2:40488	*See* AD-A-029489
TID-3317-S7	2:40603	Dep. NTIS, $6.00
3339-S1	2:39488	Dep. NTIS, $11.75
3352	2:39348	Dep. NTIS, PC A07/MF A01
4590	2:39651	TIC
26113-P2	2:40369	Dep. NTIS, $7.75
27407	2:39664	Dep. NTIS, PC A03/MF A01
27444	2:39658	Dep. NTIS, PC A05/MF A01
27475	2:39704	Dep. NTIS, PC A02/MF A01
27494	2:40673	Dep. NTIS, PC A05/MF A01
27509	2:40071	Dep. NTIS, PC A09/MF A01
27552	2:39610	Dep. NTIS, PC A02/MF A01
27554	2:40497	Dep. NTIS, PC A07/MF A01
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